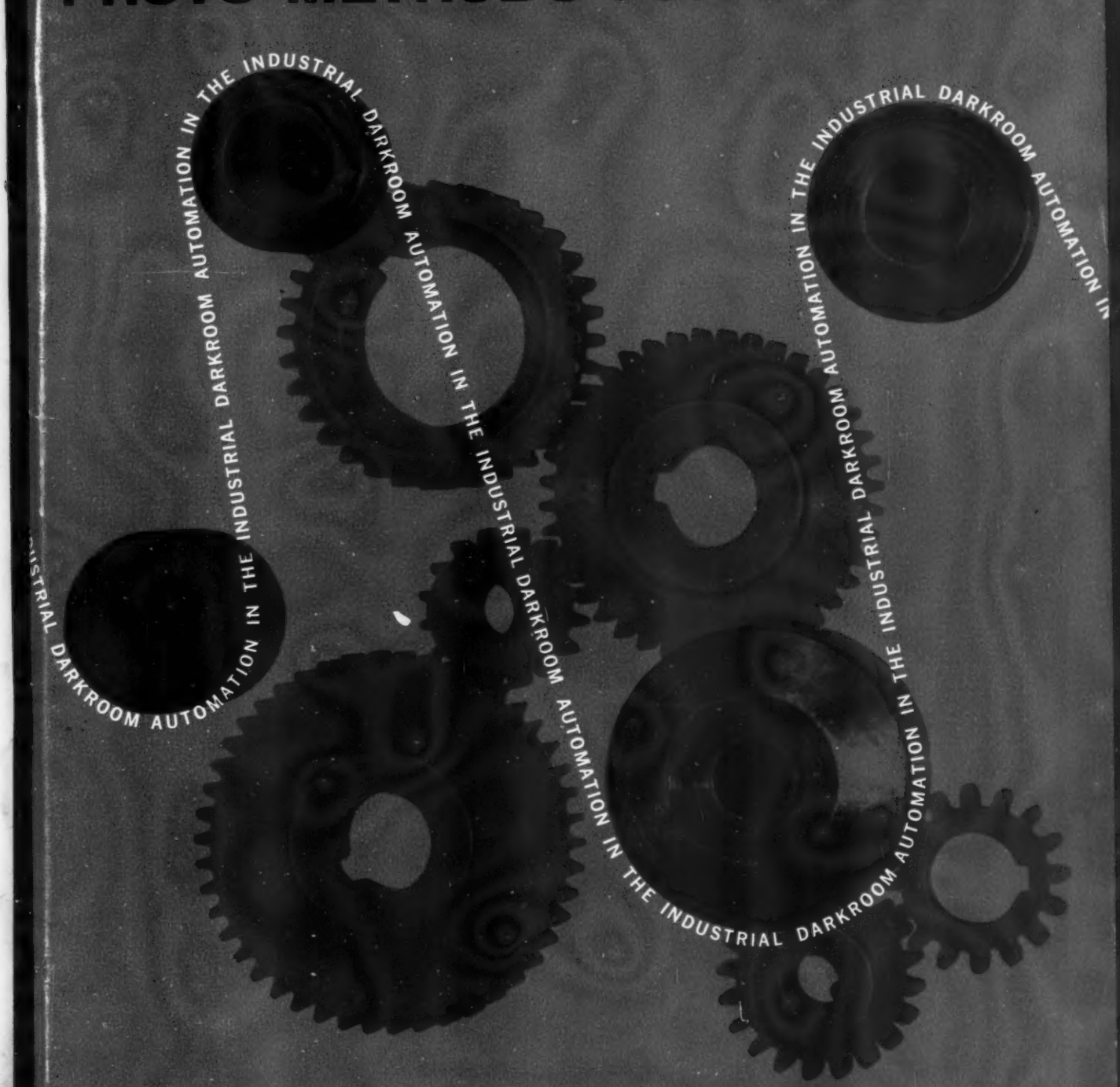
PMI

PHOTO METHODS FOR INDUSTRY

VOL. 3 NO. 8
AUGUST
1960
PRICE 50c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The Variables in Photography

...Require The Film with the Inherent Safety Factor!

Gevaert Gevapan Sheet Film has built-in latitude to accommodate the many variables in photography. Light source, camera shutter, developing time/temperature, chemicals . . . and human—the variables that often spell failure to a film with less tolerance. Small wonder, therefore, that Gevapan finds its way into so many professional holders. Want to try Gevapan for yourself? *Write for professional samples, stating your film size.*

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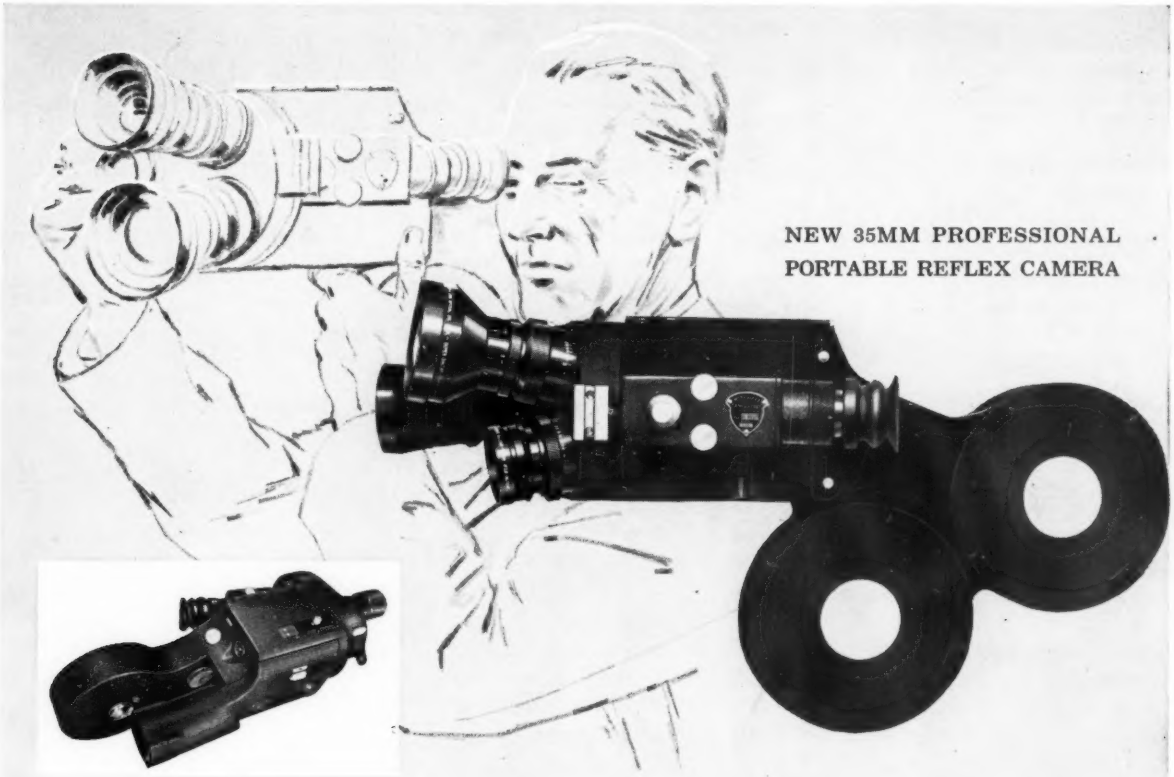
NEW

MITCHELL R-35 *Reflex*

Hand Held or Tripod Mounted*

Here for the first time *is a 35mm reflex motion picture camera which combines streamlined lightweight design with the full range of professional features. Its superbly engineered design by Mitchell—the world's leading source of professional motion picture cameras—assures a remarkable versatility in filming. Among the broad capabilities of the R-35 are: theatrical and television productions—on location and in the studio; underwater use; high speed instrumentation films; and both animation and stop-motion.*



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MITCHELL R-35

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CORPORATION
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Cable Address: "Mitcamco"

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LEICA rugged tool for industry

EXTREME TEMPERATURES are well tolerated by the LEICA. The camera with the world's finest focal-plane shutter serves efficiently in arctic expeditions as well as in the tropics, resists "freezing."

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38460

Get more information. Circle 446, page 63

Kodak
INDUSTRIAL
ROUND-UP

Talent, Craftsmanship, Guesswork, Drudgery

Once it took all four to be a photographer. Then Kodak introduced *uniformity*, and guesswork died. Now comes AUTOMATION FOR THE PROFESSIONAL in answer to another urgent need...

It's a solution—to ease high costs, broaden narrow margins, extend seemingly shorter working days, help you meet the insistence on speed in the face of growing and varied demand. An answer to high overhead, high payrolls, high rents, high taxes.

Automation!

Indeed, something like automatic processing is a handhold, a simple means for survival today... enabling the large operator to profit reasonably, enabling the small operator to grow as he intends to.

The only question to ask is: How is automation possible for the professional?

The only answer

If you were alive when wet plates went out, you remember when guesswork died. It was about the time when *uniformity* was born at Kodak Park... when films, paper, and chemicals were made predictable.

This same Kodak uniformity today is what makes labor-saving automation possible for the professional. Because only with professional films, papers, and chemicals that will act predictably is it possible to formulate precisely for machine processing.

With materials uniform, it becomes a relatively simple matter to design a machine for those materials. A machine that will end drudgery. A machine that will do the routine darkroom work that follows, but does not really involve the photographer's true talent, his creativity.

Why shouldn't a machine process prints? Develop precisely? Short stop to the instant? Fix thoroughly? Wash fully? Even tone, if necessary, to exactly the tint you want? Dry to perfection? Roll up prints in neat, pre-assorted order?

These operations have always been "mechanical" and no challenge to the talented professional. Why not automate them? And with Kodak material uniformity, the automatic operation is applicable to color as well as to black-and-white.

It's been proved: one machine can process prints faster than a number of people, with less waste, with the most consistent quality, with no loss (indeed, with complete retention) of creative quality, and with a welcome lower cost per print than is possible manually.

Automation adds to creativity

Automation releases the professional and his co-workers from some of the unchallenging labor of time-consuming processing. It gives him additional time for furthering his picture-taking techniques. Or, for some, it may be simply a way to relax, to get time to think.

What is creative about splashing around in chemicals, watching a clock, worrying about temperatures? Why should you transport prints from bath to bath to wash? No longer need you dive around in a wash tank for a print you can't seem to find. No more sorting problems. No more feeding a dryer. No more failures due to inadequate chemical or wash treatments.

With uniform materials these become jobs for a machine... for automation... not for a professional.

And this, it seems, is as it should be.

Kodak automation the only complete system

Not merely continuous print-processing machinery, but rather a precisely created professional system. That's how Kodak has designed for automation.

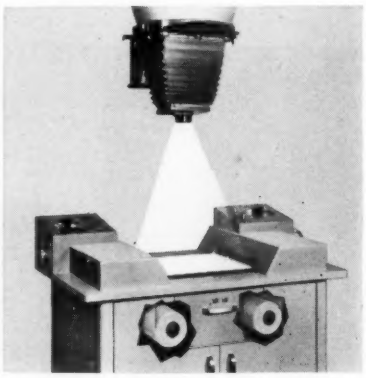
This Kodak system is unique because it combines the uniformity of Kodak papers and Kodak chemicals with the precision of Kodak machinery made expressly for them.

It is a system complete with proved and *guaranteed* formulations for black-and-white or color processing of Kodak professional materials. A system where all the ingredients are made together by Kodak to work together for you, to provide optimum quality, consistent quality, predictable quality.

For these reasons, this is the only professional automation system we know of that is ready for you now.

The machinery, the speed, the cost, the savings

Automation starts at your easel. The objective is creative quality, speed, and low cost.



This is the machine you begin with: Kodak Automatic Roll Head Printer. It replaces the manual easel under your enlarger.

With it, you can automatically print one negative a thousand times with consistent quality without touching the equipment. Or you can print a thousand negatives one or more times with dodging, burning in, or other creative manipulations.

The machine advances the paper roll automatically for many exposures of one negative, or at push-button speed when you're printing single negatives.

If your volume required it, one skilled man could keep three of these printers busy. Or one man and one Roll Head Printer, with consistent negatives, can print creatively at a rapid rate.

Step II, the ribbon of prints. Perhaps the first thing you will notice about any Kodak Continuous Print Processor, regardless of its size, is the floor space it *does not* consume.

These machines do their work in ⅓ less space than is required for a comparable volume of handwork.

If, for example, you require 1500 square feet of floor for processing prints now, you will require only 500 square feet with Kodak automation.

In the face of today's high rents or industry's high departmental burden rates, this saving in floor space becomes significant.

And one man, operating large processor or small, does *all* of a studio's printing—whether color or black-and-white.

He starts the ribbon of prints through, comes back later to a neatly rolled-up package of finished business all ready for automatic cutting and delivering.

Replenishment, temperatures, timing . . . all automatic. Chemicals stay at their working best much more accurately, in fact, than is possible in manual processing.

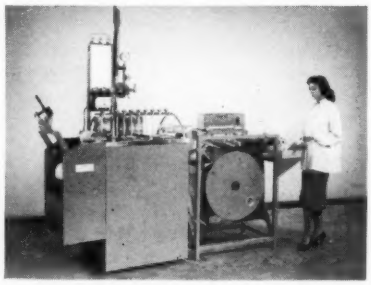
You should even make certain savings on chemicals. There is little or no wastage. And basic Kodak formulations for automation, including automatic replenishment, are so highly perfected that you use chemicals to the exact point of exhaustion and not beyond.

No developer drop-off, no weakened hypo, no chemical worries at all.

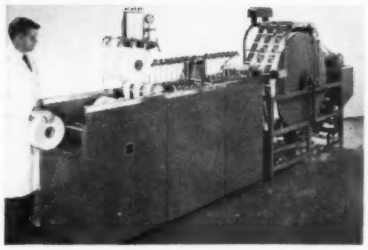
Such precise chemical control helps considerably in keeping gremlins out of prints, voiding the possibility of having to run costly make-overs.

Which machine for you?

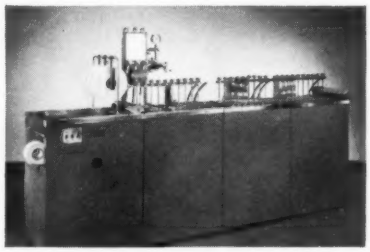
It doesn't make too much difference which *size* Kodak Continuous Print Processor you start out with. They are all complete units. They are all designed to a module. This means that you can start as small as you like; then, as your needs expand, you can add one unit to another, the new to the old, like building blocks. Your machinery keeps up with your progress that way, one part helping to pay for another.



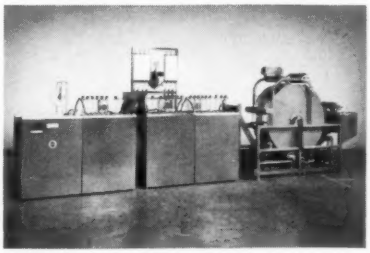
1. This, the smallest Kodak processor, has single-module unit. Add to it a Kodak Roll Head Printer and you're in black-and-white automation.



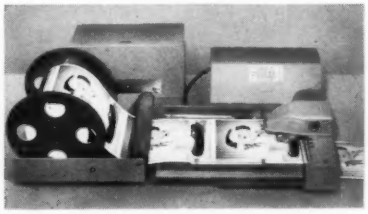
2. This is the next largest Kodak processor, complete with paper feed table, *two* single-module processing units, controls, and dryer . . . offers double capacity of the smaller unit.



3. This larger unit is the same as 2 except for the additional single-module unit. The only reasons you would want this over the other machines are: for increased speed or for toning.



4. With the above machine you're ready for automating color work. You won't find a more precise way to obtain consistent color quality. This equipment can be added to your black-and-white modular units, after certain plumbing changes to accommodate additional solutions required for color work.



5. Whichever one of the Kodak processors you require, you would also need this Kodak Automatic Cutter. It feeds and cuts finished prints either automatically or manually, as you desire.

Who is ready for automation now?

There's no question about the benefits of automation to *portrait photographers.*

Big studios use it to save money while gaining speed and time, enabling them to add volume while maintaining quality.

Smaller studios use it to save time and make money with a small staff.

Both large and small studios use it to broaden their capacity in color work and its control.

Any *industrial photographic department* which keeps three men busy printing can save enough on printing alone to justify automation. Savings in floor space, increased delivery speed of quantity work, the consistent quality, print after print, the possibility of lower costs for color . . . *these are bonuses.* (And wasn't it in industry that the idea for automation started in the first place? Why? To save money, add precision, conserve skilled manpower!)

Commercial studios which commit their bread-and-butter work to automation gain time to concentrate talents on challenging and highly lucrative creative assignments. Gain time also to explore new sales routes, open new business prospects, broaden business.

Your first step now . . .

You will need more information than is presented here on which to base your automation commitments. Many of your questions can be answered by reading the new "Kodak Equipment for Automation." An inquiry to the Professional and Graphic Reproduction Apparatus Sales Division, 343 State Street, Rochester 4, N. Y., will bring your copy by return mail.

Since automation is so important to you, we have assigned the sales responsibility for this Kodak equipment exclusively to the men who understand your area in professional photography perhaps better than anyone else in the field. These men are the Kodak Professional Technical Representatives.

Talk with your T. R. He is close to your business. He is aware of what automation can and cannot do for you. He knows the technicalities. He can help complete your thinking. Answer your questions. Give you an honest opinion. Why not call him to discuss it?

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It Costs No More to Own the Best*

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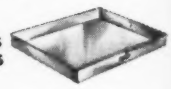

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F.Y.I.

When it comes to photography in industry, we must confess a certain parochialism in our attitude. We feel that it is a good thing on general principles. However, it is always a relief to find specific examples of the benefits conferred on mankind in general and industry in particular by photography. One example, which came to light recently, was at Smith and Loveless.

This company builds sewage lift stations which are installations designed to raise the level of sewage in a system. In the natural course of events, it was felt that a movie which could be shown to customers would aid sales efforts. Accordingly, the advertising manager, a rank amateur, set out to learn all about movie making with the aid of Kodak publications, personal advice and sad experience. Eventually, the result was an excellent film which is shown to customers, visitors and employees.

One showing was to an unusually interested audience, the Board of Directors of Union Tank Car in Chicago, considering joining S & L to the Union industrial complex. The film enabled them not only to "visit" the plant but to see what products were made and how they were used. The eventual outcome: Smith & Loveless became a division of Union Tank Car Company in December, 1959. Alden Smith, managing director of S & L called the film "the most effective sales promotion tool in our advertising budget."

Every once in awhile, we do a product story in which our wires get crossed. There was a case of crossed-wires in the July issue in *A Card At A Time*. The Foto-List camera is credited with filming a single line on a card; advice from the company is that the Foto-List will record multiple lines, as many as will appear on half the card's depth. It can also mask out any area desired on the card so that changes or additions can be inserted later.

Speaking of our last issue . . . Julius Shulman who was featured in *Construction Cheesecake,* a discussion of architectural photography by a recognized expert, has been retained by Westinghouse Electric to photograph 16 specially-designed Total Electric Homes being built

(*continued on page* 11)

sleep like a kitten

Why loose sleep worrying whether color work will be ready on time?

Instead, go right to K & L with your requirements for Dye Transfers & Ektacolor ("C") prints for reproduction, comps, displays, color processing, flexichromes, transparencies, slides and filmstrips. Be sure of finest, exact color reproduction **delivered on time.** Discuss problems with K & L's top technicians — Sam Lang and Len Zoref. Call or write for free Color Data Handbook and complete Price List.

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to score your films by
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—20 Times less toxic than carbon tetrachloride

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when you are ready to spend $489.50 for a camera... you are ready for the

zenza

BRONICA

2¼ square, single-lens reflex

When a man is ready to invest $489.50 in a camera, his choice deserves the most serious consideration. There are two cameras in the field priced at $489.50, both 2¼ square, single-lens reflexes. The following comparison table shows certain vital differences between these two cameras which should prove most valuable in helping you make your selection. One of these cameras is the Bronica. See if you can tell which.

	CAMERA 'X'	CAMERA 'Y'
shutter	between-the-lens	focal plane
speeds	1 sec. to 1/500th	10 sec. to 1/1250th
delayed action	approx. 10 sec.	adjustable: 1 to 10 sec.
lenses	interchangeable only when shutter is wound	interchangeable at any time
each lens requires shutter	yes	no
widest angle lens	60mm f5.6	50mm f3.5
normal lens focusing range	3½ ft. to infinity	19 inches to infinity
diaphragm action	stops down automatically for exposure — must wind shutter to reopen	automatically stops down for exposure — instantly reopens to full aperture.
instant-return automatic mirror	no shutter must be wound to reset mirror to focus position	yes automatically returns to focus position after exposure
film back interchangeability	to replace or interchange backs attention must be paid to whether film or shutter had been previously wound — and appropriate adjustment made	back may be replaced or interchanged without any attention to whether film or shutter has been wound. Camera responds automatically.
film loading	must observe visual indicator when winding to #1	automatically stops at #1 exposure position
safety film-slide	camera can be fired with slide slightly withdrawn (⅛")	camera cannot be fired unless slide is completely withdrawn
film-slide lock	no slide readily removable when film back is off camera	yes slide cannot be withdrawn when film back is off camera
special film flatness device	none	automatic film tension system keeps film flat for exposure — relaxes when film is advanced
auto-reset exposure counter	no	yes
focusing lock	no	yes
price	$489.50 with 80mm f2.8 lens	$489.50 with 75mm f2.8 lens

There is one special Bronica feature which cannot go unmentioned. Interchangeable Auto-Nikkor lenses are standard Bronica equipment—supplied in normal focal length with the camera, and available in interchangeable wide-angle and telephotos. See the Bronica at your photo dealer this week. For complete details, write to Dept. PMS

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uniform prints

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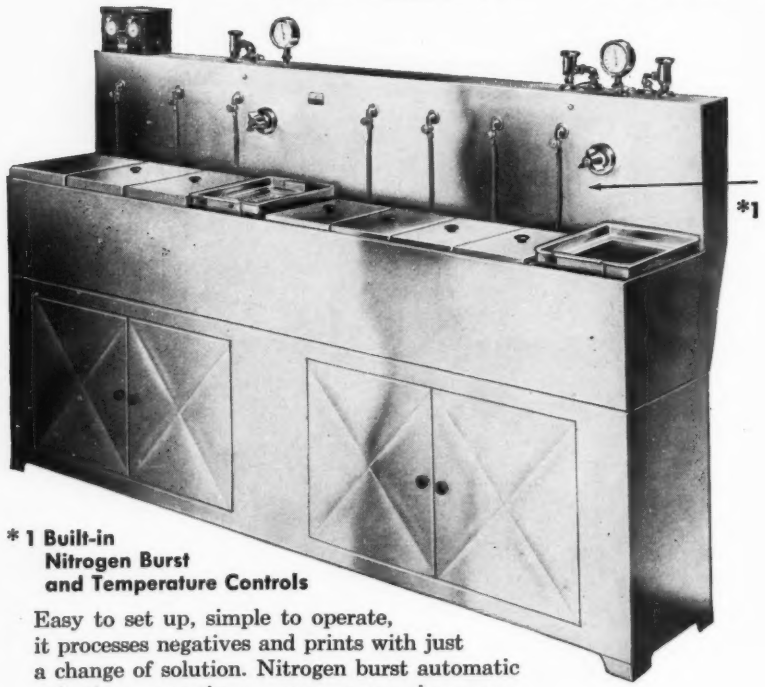
calumet color processor

guarantees uniform development of each batch of film . . . along with uniformity from batch to batch



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***1 Built-in Nitrogen Burst and Temperature Controls**

Easy to set up, simple to operate, it processes negatives and prints with just a change of solution. Nitrogen burst automatic agitation saves time, saves money, gives accurate, uniform quality. An investment that quickly pays for itself. Three sizes for color materials . . . 8 x 10 - 11 x 14 - 16 x 20.

The price is unbelievably low for a complete processor

Write for catalog

Calumet

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Manufacturers of Cameras, Photographic Processing, Studio and Laboratory Equipment

Get more information. Circle 417, page 63

COMING UP

AUGUST 15-19 High-Speed Seminar at MIT. Stroboscopic Light Laboratory. Cambridge 39, Mass.

SEPTEMBER 8, 9 All-Ohio Conference on Technical Communications at the University of Dayton, Dayton, Ohio.

SEPTEMBER 21-24 ASMP Photojournalism Conference. Asilomar Conference Grounds, Asilomar, Calif.

SEPTEMBER 24-OCTOBER 7 Photokina-International Photographic Trade Fair. Cologne, Germany.

SEPTEMBER 26-30 Instrument Society of America's 15th Annual Instrument-Automation Conference and Exhibit, New York, N.Y.

OCTOBER 10-13 Fourth Annual Industrial Film & A-V Exhibition. New York, N.Y.

OCTOBER 14, 15 Society of Photographic Scientists and Engineers Symposium. Washington, D.C.

MONTHLY MEETINGS

Association of Federal Photographers Meetings every third Wednesday at 8 p.m. G.S.A. Building, 7th and D Sts., S. W., Washington, D.C.

Cleveland Chapter SPSE Meetings the first Tuesday of each month. Cleveland Engineering & Scientific Center, 3100 Chester Ave., Cleveland, Ohio. Contact Robert E. Birr, General Electric, Nela Park, Cleveland, Ohio. GL 1-6600.

Rochester Chapter SPSE First Monday. Contact Woodlief Thomas, Jr. Color Technology Division, Building 65, Kodak Park, Rochester 4, N. Y. CO 6-2500.

Industrial Photographers of America Essex House, Newark, N. J. Meetings every second and fourth Thursday. Contact Tom Holbarton, 181 Lake Drive West, Packanack Lake, Wayne, N. J. Or R. Handley, The Port of New York Authority, 11 8th Ave., New York 11, N. Y. AL 5-1000, Ext. 605.

National Visual Presentation Association, Inc. New York City. Meetings every second Thursday. Contact M. E. Schack, 19 West 44th Street, New York, N. Y.

(*continued on page 60*)

F.Y.I.

(*continued from page* 8)

throughout the United States. The Total Electric Homes, designed by leading architects to fill the needs of various types of homeowners—large family, small family, rich family, poor family, etc.—will show how only one source of energy will perform every function in a home.

Medical photo congress

The First International Congress on Medical Photography and Cinematography, scheduled for September 27-30, 1960, in Cologne, has been shifted to Dusseldorf. The reason is the huge number of visitors in Cologne for Photokina and the limited quantity of desirable accommodations. It is felt that the change will permit visitors to the Congress to have a better choice of rooms. The new site is 45 minutes from Cologne.

Gary Robert Greenfield, 17, of Hewlett, Long Island, has been awarded the Rochester Institute of Technology Scholarship for 1960-61, awarded by the Professional Photographers of America. The selection was made by the trustees of the Winona School of Photography.

William C. Raftery is the new Sales Manager of Printec, Marty Klaus, vp-sales, of Azon announced recently. Raftery, a former colonel in the army, was wartime chief of the reproduction plant in the Pentagon.

Among the 1960 winners of Junior Book Award medals was Herbert P. Paschel, PMI's specialist on Reproduction and Graphic Arts, for his book, *The First Book of Color*, published by Watts.

Miss Elsie Garvin, head of the Kodak Research Library since 1923, has retired after 40 years with Eastman Kodak. During her stay, she has seen the library grow from 5,000 to 30,000 volumes.

Miss Jackie Martin is now vp for sales and public relations of Washington, D. C.'s Norwood Studios, the capitol's largest producer of motion pictures. Miss Martin has had a spectacular career as war correspondent, news photographer and former photographic and art director of the *Washington Times-Herald*.

Rapid Processing will be the subject of a symposium at the Society of Photographic Scientists & Engineers in Washington, D. C., October 14 and 15.

For photographers who live, sleep and eat photography, Maplewood Manor, Betterton Beach, Md., offers itself as the only hotel exclusively for photographers and family. The host is Gerry Clarkson.

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by Edward R. Farber

ELECTRONIC FLASH

A new unit for do-it-yourselfers; new references, explosive issues

Even if you have no intentions of being an electronic flash do-it-yourselfer, a how-to article on page 56 of the July, 1960 *Electronics World* is first-rate reading, just for general background in the subject. The whys and wherefores of the design and construction are explained with a minimum of technical talk.

If you do want to build your own unit, the article will tell you how to build a *Professional Electronic Photoflash*, the title of the story, using nickel-cadmium batteries and a simplified economizer circuit. The flash head contains a voltmeter rather than a ready light—a useful feature for exacting color photographers.

The 100-watt-sec. unit will produce 150 shots with freshly charged batteries, but the stated 15-sec. recycling time seems unduly long.

Consumer tests

Also required reading for electronic flash enthusiasts is an evaluation of six low-cost battery units, reported in the July, 1960 *Consumer Bulletin*, page 21.

Units rated were the FR150, Futuramic Strobonar 64B, Mecablitz Color SL and the Graflex Strobomite. The Braun Hobby was not included, though it fits into the same price class.

Commentary seemed very fair and correct to this observer, as far as it went, but blind reliance on the recommendations might not be justified, particularly when only one unit of each brand was tested. The test coverage of the reflectors of the Heiland and FR units is shown in an interesting photograph. It's the kind of test more photographers should make before buying.

Wise words

Since we are pushing the printed word, let's add a new book to that reading list, *Electronic Flash Photography* written by Ralph L. Aspden and published by Macmillan, New York, 1960.

It's a survey of principles and practices in the electronic flash field—and well worth the $8.50 price. Though it is an English book, the somewhat unfamiliar technical verbiage is not confusing and is good reading for any industrial photographer.

Chapter headings cover Radiant Energy, High Intensity Flashtubes, Circuits and Applications, Photographic Considerations, Specialized Techniques, Experiments and Research, Commercial Flash Equipment and Flash Radiography. Circuits for repetitive flash units, delay lines for lengthening the flash, short duration flash units and various types of triggering systems are given. Specific examples of practical problems solved are provocative and should be stimulating to all photographers. The book can be ordered through Amphoto, 33 W. 60th St., New York 23, N.Y.

English unit

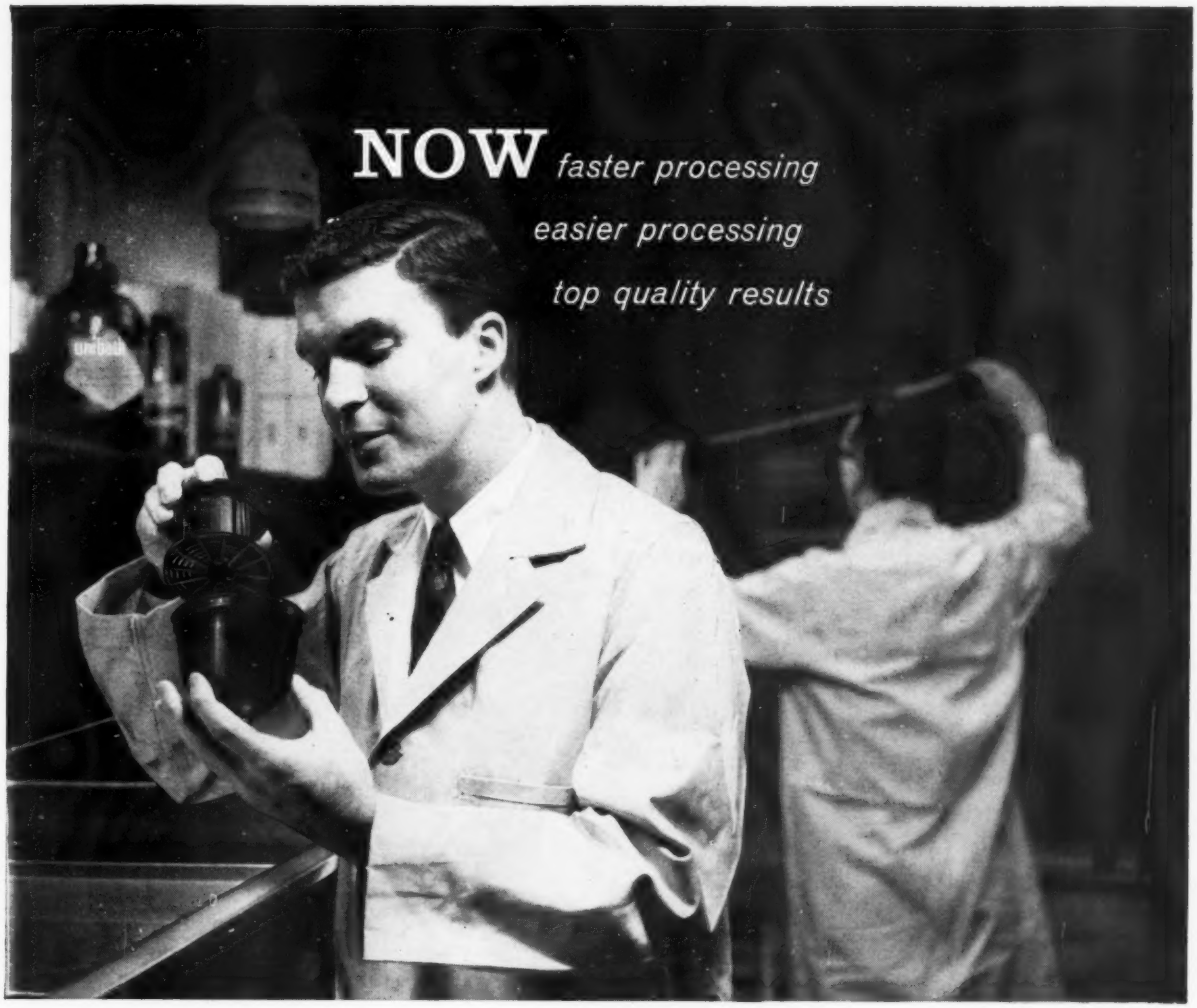
We have reviewed an English book so it is appropriate to review an English flash unit distributed in North America by Electrolabs, 7385 St. Lawrence Blvd., Montreal, Quebec, Canada.

The Courtenay 5000 Mark 1 is a color unit that will put up to 5000-watt-sec. through one flashtube. Up to five flash heads can be operated from one pack. Operation is from 120-volt AC, and photo-tube triggering can be used to trigger several units simultaneously.

Flash and explosions

Photographers have frequently asked about the safety of electronic flash in explosive atmospheres. This department has always said not to count on it—too many unknowns. However, after many years of research the U.S. Bureau of Mines has approved a design of an explosion proof unit for *flashbulbs*. It will be manufactured by the J. B. Nottingham Co., Inc., 441 Lexington Ave., New York 17, N.Y. and has the redeeming feature that it can be used as a slave unit as well as a master

(*continued on page* 14)



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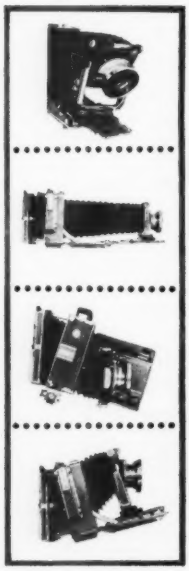

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flash at the camera.

The fact that flash lamps have been with us for some 25 years and that there has long been a demand for such an explosion-proof unit, is indicative of the care that must go into the design and testing of such a device. Don't risk using electronic flash equipment in the explosive atmosphere of operating rooms, mines, flour mills or other places where explosive dusts or vapors are present.

Modeling light patent

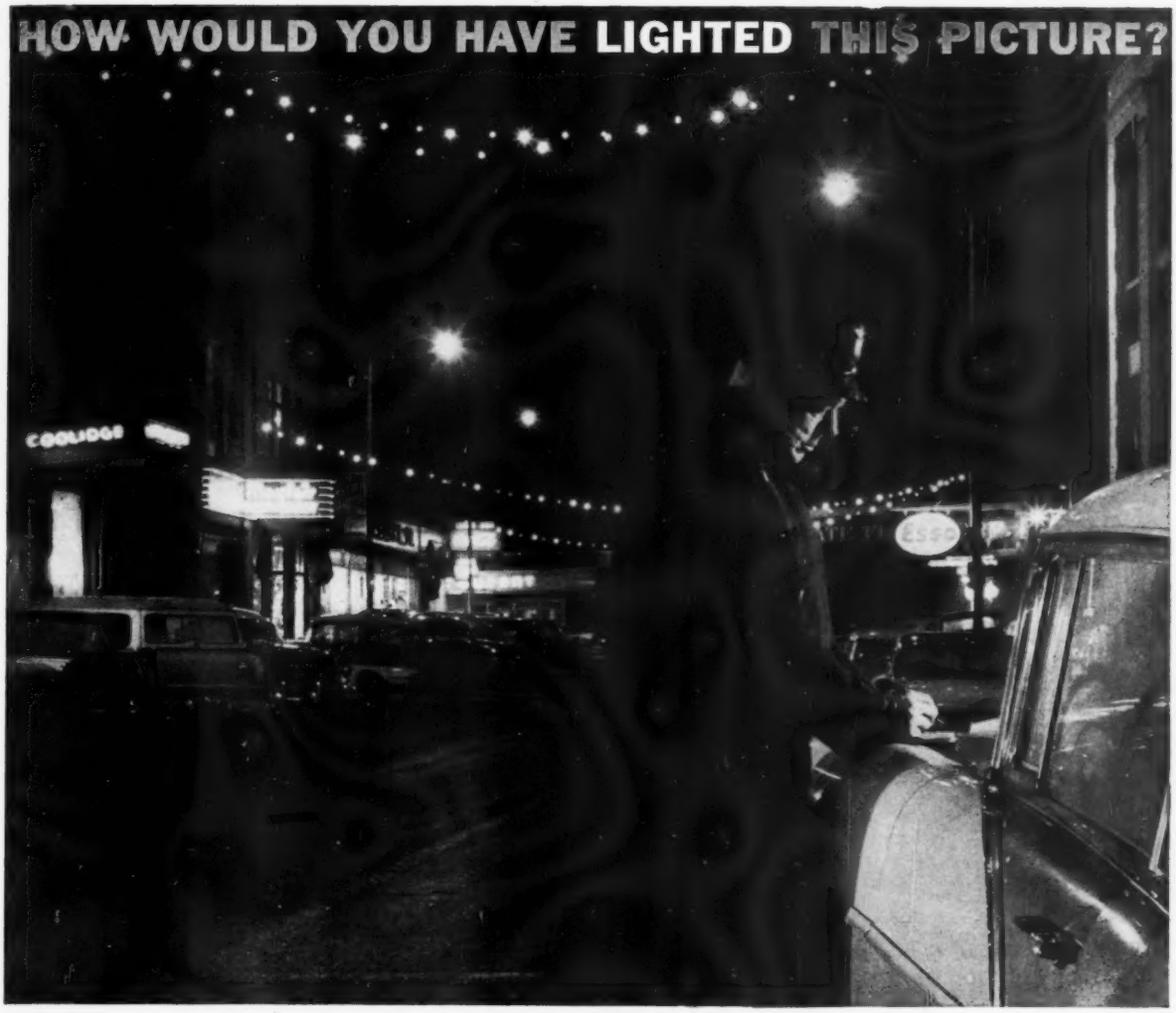
Charles Witterson of Round Lake, Ill., was recently granted a patent (which he assigned to the Kemlite Corp. of Chicago) providing for a means of keeping a flashtube in a continuous glow of such intensity that it can be used for a modeling light and at will, a regular flashtube. Of course, the purpose of the device is to eliminate the unsatisfactory type of modeling methods where the incandescent light is put within or behind or in front of the flashtube helix. Kemlite does not intend to manufacture the unit, but will make the tube and the patent available to others to manufacture.

Color temperature

A response by James Daniels of Kemlite Laboratories to a question from a user as to why they did not make a flashtube specifically to match daylight seems worth quoting: "Our research department is running a series of extensive tests in this field. The radiation of a flashtube has been found to be dualistic in nature and the light created by the electrical discharge will vary according to the power input and voltage, and will cover a range from 6000 to 9000K with a peak of about 6500. For all practical purposes, however, we can assume that it is slightly on the blue side in reference to sunlight. The problem is further complicated by the fact that there is no definition of daylight, although the curve of a conventional xenon-filled tube very closely approximates that of noon daylight in Washington, D.C. To answer your question directly, no flashtube can be made which will generate only in the region of 5500 to 5600K because of the very nature of the condenser charge."

Battery brochure

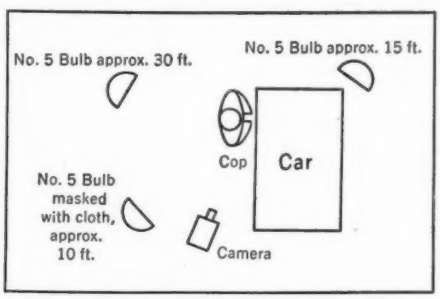
A new, 10-page brochure on the Yardney Silvercel batteries has been issued and copies may be obtained from Yardney Electric Corp., 40-50 Leonard Street, N.Y.C.



NEWS PHOTOGRAPHER DAVID MATT FINDS G-E No. 5 FLASHBULBS JUST THE TICKET FOR LIGHTING DRAMATIC NIGHT SHOT

"Last winter while doing a picture story on people who work nights in White River Junction, Vermont," says David Matt of the *Valley News*, "I took the above photograph. My problem here was to preserve the night effect and still have enough detail in the darker areas to reproduce in our paper. I also wanted to stop down, so that the lights in the street would have the sunburst pattern.

"My solution was to set my Rolleiflex on a tripod and use f/22 on bulb with a locking cable release. I then fired three G-E No. 5 Flashbulbs to light the scene. (See diagram.) I masked the No. 5 Flashbulb closest to the camera with a cloth. Exposure time was about 20 seconds. It's been my experience that G-E is the bulb you can count on to deliver the punch you need every time!"



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Get more information. Circle 430, page 63

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by David B. Eisendrath, Jr.

WORKING PHOTOGRAPHER

Some comments on selling photographic service to management

My mail is heavy. I get a flood of envelopes every day (except Sunday) and along with the usual load of junk mail (I read it all, for ideas) personal and business correspondence, to say nothing of organizational affairs, are almost daily letters from friends in the industry—industrial photographers. Heads of photo departments, free-lancers, a technician looking for answers. A few weeks ago I was discussing with the editor of PMI the trend of letters I had been receiving with a truly depressing note. Within one week, three good friends had written in detail and despair about how their photo departments were being cut down, people were being let out, and budgets slashed. He quickly called my attention to letters we had just received at PMI telling of expansion programs, new darkrooms and studios, and purchases of major pieces of equipment. What does it all mean? I wish I knew.

I'm baffled that photo departments in industries in Michigan and Arizona, Louisiana and Pennsylvania are being cut in half by companies who appear to be successful and smart, and whose stock continues to climb in this current period of high prices and inflation. I can understand what is happening to people in the aircraft business. Those whose designs for planes or missiles seem to hit the spot have orders and money; those squeezed out have to wait till next time around. But the cut-backs in photography elsewhere are bewildering.

One thing that seems apparent, though, is that the growing, building, expanding departments have all sold their management strongly on the value of photography. When I see what important and valuable *functional* services are beng performed by, say, Dick Kinstler's crew at Procter and Gamble, or by Roy Wolford's group at Northrop, I'm convinced that there is something in selling your department. Some years ago Ed Paeltz of Laclede Steel Co. gave a talk at the National Industrial Photographic Conference called, *Don't Sell the Photograph—Sell the Service.* It occurs to me that this valuable advice offers a certain amount of insurance.

To my mind, there are several important factors involved in proving to management that the photo department is not a luxury. First off, basic functional photography is always a good foot-in-the-door. Getting a half dozen ideas where photography serves to save money, time, or material and trying to apply them to your own plant makes sense, whether it be as simple as teaching truck drivers to make pictures of accidents with box cameras, or the receiving department supervisor that a photograph of a faulty loaded truck or freight car helps settle claims. Simple and sweet, but if you could show that a dollar spent for photo materials would quickly help to settle a claim, you might be on your way to better things.

I've always felt that the way to a management's heart was through its pocketbook. The photographs that sell photography are those which put photography to work in some of its many unglamorous, functional ways; not in the making of pretty pictures (though quality can't be sacrificed) but where quantitative information is provided. When you have sold the concept that it's not what photography will cost, but how much management wants to save, you're well on the way.

Another point in selling is to show that your cost is within the standard going commercial rates in your area. Many times you produce for less than an outside competitor but many times your advantage is that you are on the spot, are familiar with the product or operation, and can produce. I'm not against excluding a fresh point of view as offered by a competent outsider, I'm just trying to say that selling your ability is important. Many

(*continued on page* 18)

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WORKING PHOTOGRAPHER

(*continued from page* 16)

industrial departments have lists of standard prices for commercial shots and will prepare a quarterly report on how much it would have cost to have much of the work done without your own department. (I have a whole folder full of price surveys from various states; they are useful as a guide. The Commercial Photographer's Ass'n. of Oregon puts out a survey regularly; I'll send details if you want.)

There are also many simple ways to keep drawing attention to the fact that your department is made up of live-wire operators who know what they're doing. Pete Jowise at Shell Development, for example, told me that he not only sold his management on having some of his people attend technical professional photographic meetings, but makes a point of using company transportation to go to them. A hard selling job? Maybe, but at least they know that Pete and his boys spend some of their after-hours trying to learn things that will eventually save the management money and bring more skill and know-how to the department.

I don't know who started this one, but several photo departments I've been in recently had in the display of photographs on the office wall an empty frame and a small card saying "This Print Gone to an Exhibition in Chicago." It attracted attention, made the point very quickly that the photographers in this shop were technicians of exhibition caliber.

One of the reasons that the National Industrial Photographic Conference is a *conference* and not a convention is because the *conference* term more strongly points out just *what* these meetings are—serious program sessions. I'm still amazed at the number of supposedly enlightened, progressive corporations who don't let their photographers attend such meetings. Evidently they have not been sold on the idea that a photo department is not a luxury item.

How to start selling? How to get that foot-in-the-door? Show someone how to save money or time with photography.

Maybe this looks like you're trying to show you don't have enough to do? Far from it, it may help to convince how important your department is and how it can play even a more important role.

At least, that's what it seems to me is the reason that those photo labs we analyze in PMI seem to be expanding and moving into better and bigger quarters.—THE END

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Leslie Mc William, Director of Photography for Lederle Laboratories has kept up with an almost incredible increase in demands for pictures in department after department. Running the gamut from quantity production to extreme precision in areas as diverse as Research, New Products, Engineering, Building Progress, Advertising, Public Relations, Community Relations, Guest Relations, Internal Publications, Executive Portraits and Educational Programs posed 2 basic darkroom problems. Only Beseler 45MCR's solved these problems.

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2. The Beseler 45MCR's with their fast, precise motor elevation made it possible to produce as many as 100 prints per hour. With 4 Beseler 45MCR's in action this meant large orders could be filled in a reasonable time with better quality and lower cost than copy houses. (Photo Director Williams observed that the motors, used constantly since 1956, have required no repairs.) In addition, the twin condenser system saved many hours by eliminating changing of optics for a variety of negative sizes including 35mm, 2¼ x 2¼, 4 x 5 and odd sizes for special camera equipment.

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by Arnold Eagle

INDUSTRIAL MOTION PICTURES

Animation techniques for the in-plant man from the F&B seminar

One of the most useful sources of technical information open to the film maker is the motion picture equipment dealer or salesman. Whether or not he is a customer, the film maker will usually receive a friendly reception and helpful suggestions. Of course, the helpful interest is not entirely altruistic, but an investment in good-will and insurance against poor results which the customer, who does not know the equipment, will blame on the dealer who sold it.

The New York-based cameramen, one of whom is this writer, has three excellent sources of information—S.O.S., Camera Equipment Co., and Florman & Babb. There are, of course, similar firms in other major cities.

The practice of training the customer reached a high level in June of this year when Florman & Babb gave an intensive four day seminar in animation techniques. More than 80 film makers from all over the country attended the sessions which ran from 9 a.m. to 10 p.m. They listened to top men in the field discuss every aspect of animation.

The main reason for this particular seminar was the introduction of the F. B. Triplex animation stand. In my opinion, this is an excellent stand, both because of its low price and because of its many features which are most helpful to industrial and in-plant movie makers. It can be changed from a vertical to a horizontal position with ease. The camera zoom post may be set at any angle. It can be used as an animation stand, a copy stand or a product stage in both still and movie work. It is an ideal copy stand for still photography.

Professional cartoon cell animation is a highly specialized art which requires an elaborate organization and training not available to the average industrial film maker. However, many stop motion and animation techniques are quite simple and are extremely useful in industrial, sales, PR and teaching films. A great number of these techniques can be handled to some extent without an animation stand. For professional results, however, one needs professional tools.

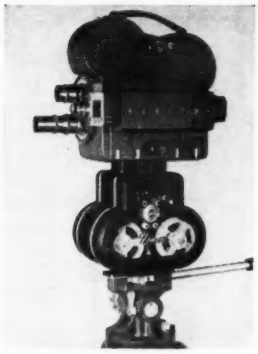
One of the most useful techniques in industrial films is the use of animated statistics, graphic charts, flow charts, maps and progress reports. It would appear that the most logical way of shooting an animated line is by stop motion with the line being lengthened after every two frames. (Most animators expose two frames for every change.)

A more practical method is the *scratch off* technique. Over your art work, you lay a cel. On the cel, draw or paint the completed line with cartoon colors. These colors don't chip and they are easily scratched off. Then you shoot it, upside down, single frame, stop motion. You can also shoot this on a vertical stand. Place the bottom of the drawing north (toward the top of the camera). After exposing a few feet on the finished line, start scratching off bits of the line, using a stylus. When you have reached the beginning of the line, you again expose an appropriate length for the start. When the developed film comes back from the processing lab, you simply cut out the shot and turn it around. The beginning is now at the end and the end of the scratched off line is at the beginning. When this shot is projected in its turned-around position, it will be right side up and the line will appear to grow smoothly on the screen.

The *disclosure method* is similar to the scratch technique. Here, art work is drawn on a black card which is covered with another blank black card. Then, as the top black card is slowly drawn away, the bottom card with the drawing or chart is revealed. Make sure that the black card is really jet black, like a *Pirosheen* card, not a dull black which will reflect light. The disclosure method is always used with double exposure. The background material is exposed first

(*continued on page* 22)

Nomad/Arriflex



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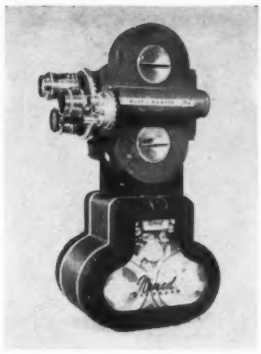

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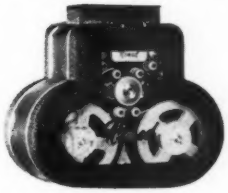
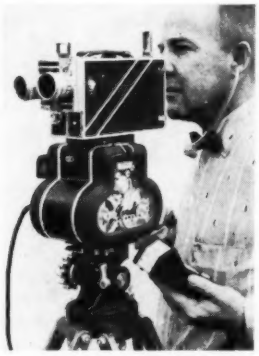


Nomad/Bolex

Nomad/Bell and Howell-240



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IND. MOTION PICTURES

(*continued from page 20*)

on the camera, then the film is rewound. Then, the statistical material is photographed using the same film. Instead of double exposure, the same effect can be accomplished in the laboratory with double printing. The advantage of this is that the background can be shot and processed at any time. Also, the graph can be drawn on a cel which is easier to register with the background drawing. The cel is then photographed separately over a black card.

The cel is a sheet of clear plastic .005 in. thick with three registration holes punched in it so that it will fit accurately on the sliding peg board under the platen, a clear white optical glass pressure plate. Using a special punch, you make holes in the art work to fit the page. The peg holes are important so that the cels can always be placed in accurate register and several cels photographed, superimposed on each other.

An elaborate peg track table has two or three peg tracks. The second or third is a floating (sliding) track so that the background cel is kept steady while the other cels are moving across. The table is usually cut out so that a light can be placed underneath for shooting transparencies, projecting a slide from underneath or projecting a motion picture background. Projection is usually done with the aid of a surface mirror placed at a 45-degree angle under the table. If live animation (continuous run, not single exposure) is shot in conjunction with background movie projection, the animation camera and the background projector must be interlocked so that both shutters are opened at the same time.

Moving cut-outs

Another useful animation technique that does not require an elaborate art department is the *cut-out* where a cut out object moves across the art work. For instance, an arrow can move along a line or a plane across a map to show a route. It is important to have a guide line to delineate accurately the exact route the cut-out will take and to measure the exact progress on each exposed frame. Making a faint line on the art work has the danger that despite care, it may show up on the finished film. At the seminar, it was suggested that a slit be cut in a cardboard corresponding with the path of the cut-out. On the edge of the cut-out, mark each move. The route for a cut-out can also be checked by drawing check marks on a cel. The cardboard

technique may be more practical as the cut-out may be moved through the slit. Of course, the cardboard must be removed before exposure.

A small cut-out may be handled more easily by pasting it on a larger cel and moving it across the background. Be careful that the edge of the cel does not show either at the beginning or at the end of a cut-out move. A white cut-out moved across a black background can be used in double exposure or double printing.

Slow starts are best

Mr. Pittaro also spoke of the problem of fairing animation. The basic idea of fairing is that any movement of a line or object should not start abruptly. Movement should start slowly, reaching a normal rate of speed gradually, after 12, 24 or 32 frames. The same is true of stopping; the movement should taper off gradually, just as it started. This is true even if there is a sudden change in direction.

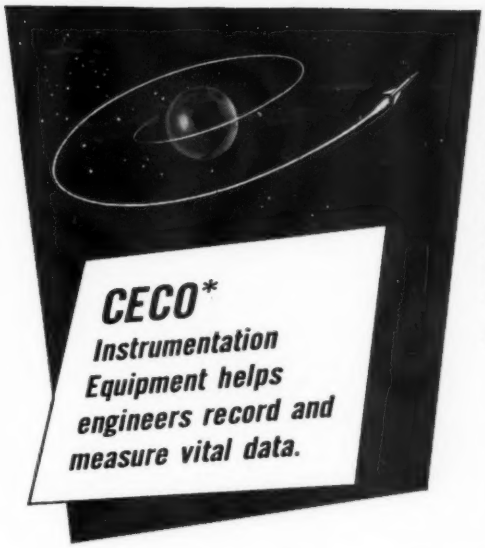
Another cut-out technique is the *Goldberg* (after Rube Goldberg). These are technical drawings with moving cut-outs, as the pistons of an automobile engine shown moving. In all cut-outs, edges must be clear and clean. Use a new razor blade and care when cutting. Edges must also be thin, so that when the platen is pressed down, the edges don't throw a shadow. They can be thinned down with fine emery paper.

Visual squeeze

Still another technique possible without an art department is the *squeeze* technique, the use of multiple still photographs, shot or enlarged in progression. The photographs are used in the same way as cell animated art work. One sample of this technique is having an object or title zoom in and out while the main picture is in one plane. This is done by preparing a series of enlargements in various sizes, then cutting them out and placing them on the main picture one by one. Squeeze technique requires a lot of work; if you assume a zoom of three seconds, you would need 36 enlargements of various sizes for cut-outs, one enlargement for every two frames.

Cost Estimator

Consolidated Film Industries of New York and Hollywood is offering a handy slide rule-type estimator for 35 and 16mm which automatically estimates running time, footage or cost of film from any one of these three factors. Send requests to 959 Seward St., Hollywood 38, California.—THE END



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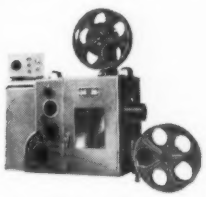

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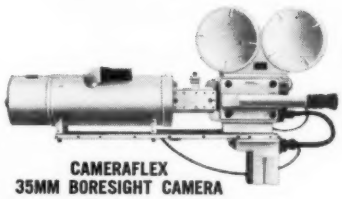

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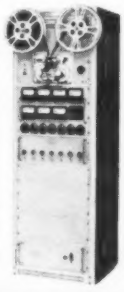

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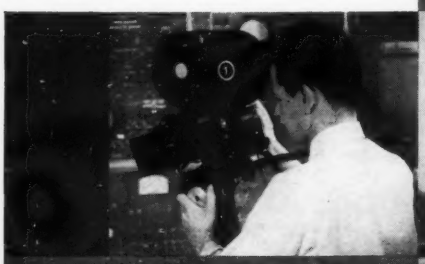
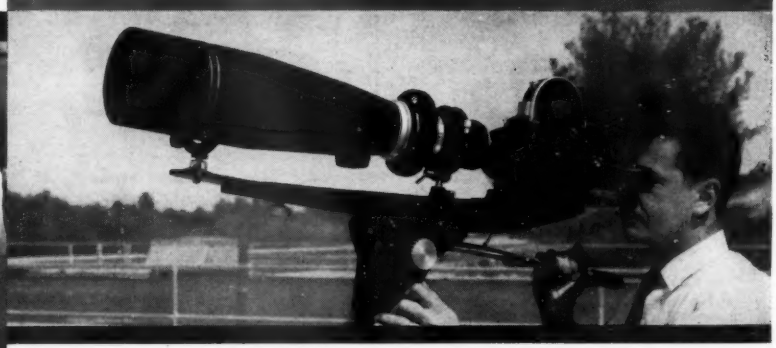
Arriflex 35 and foul-weather gear sported by Jack Philo during one phase of "data cassette program", in which a capsule in a test drop is recovered off Marblehead on the windswept New England coast. During critical experiments Arriflex motion picture cameras are in use 24 hours a day.

Here Jack Philo, Avco cameraman, uses an Arriflex 16 during "data cassette program" on Cat Island, one mile off Marblehead, Mass. That's a 32 inch telephoto lens mounted on the Arri. Avco cameramen carry the rugged ARRIFLEX wherever they travel in conjunction with this new data recovery development program.

Avco camerman Mel Miragliotta checks out telescope and 600mm lens alignment on his dependable Arriflex before leaving for the drop test site off Marblehead. The experiments were recorded from Cat Island, a lobster boat, and a high-flying plane. The one thing all have in common...an Arriflex aboard.



The Arriflex is used in-plant too. Here it is shown photographing new instrumentation in an environment test program. Through these films, the Air Force can evaluate Avco's progress on contracts to produce re-entry vehicles for Titan & Minuteman ICBM's.



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AN EDITORIAL

STOP THIEF!

We suppose that it is just as important to be a diplomat as a photographer to operate a photographic service department in industry. One hot potato the in-plant man has to handle is the matter of petty larceny on the part of non-photographic employees. ■ It goes like this. A middle executive's secretary bounces into the photo department on Monday morning with a roll of film sporting latent images of the kids at the beach. Mr. Whozits wants prints, whenever photo has time for them. The secretary doesn't start hounding until late in the afternoon. ■ It's hard enough to turn down slightly unreasonable requests for under the counter photographic materials or services from a co-worker, but when some company member pulls rank, the situation gets even stickier. It amounts to extortion. ■ Nobody smart enough to own, or to run a company is dumb enough to think that all the employees avoid snitching a pad of scratch paper or a ball point pen now and again. Some pilferage must exist, and therefore some must be overlooked. But in several respects, photographic work is a special case. The use of an efficient in-plant photo unit is an economic measure, but photographic materials aren't cheap and the time of any skilled employee counts up. Another factor is the immense appeal of photography as a hobby. Copping service from the photo department can spread like grass fire. Furthermore, in many operations the continued existence of a photographic unit depends on its ability to hold costs below that of other possible sources of photo service. Photographic pilferage may be a company expense in the short run, but in the end it's likely to be the photographer's neck. ■ The question is, how can photo ward off the free-loaders. The best system we've heard of is the work order. If the customer has a signed work order for the job, OK. It's on his conscience. Otherwise, photo is a party to the crime. Where a work order system is not applicable, tell 'em from us they should be ashamed of their brazen dishonesty.

The Editors

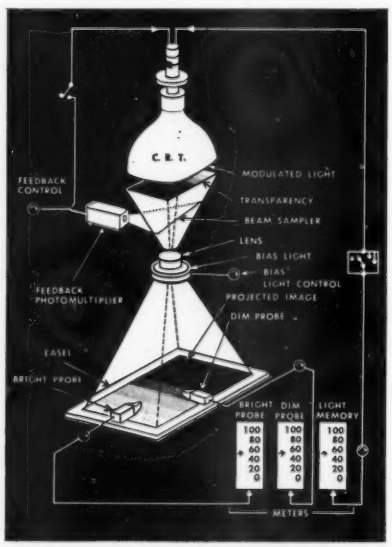
AUTOMATION IN THE INDUSTRIAL DARKROOM

A typical history of an in-plant photo department starts when someone decides that there's enough photographic work to keep a man busy. A man to do the job is found. He does a good job, good enough, at least, for people to recognize the value of photography—and assignments pop up like hydra. He needs and gets another man, then another. The better the department, the bigger the work load.

In the past, the growing demands for photographic service would be met the usual way—with another man and perhaps additional equipment. Today, however, a new word has assumed importance in industry's vocabulary: automation. Its impact on in-plant photographic work is small but perceptible. Photographers can expect to feel more of it. It's likely to loom largest when everyone in the department is swamped and expansion of some sort is indicated.

There is automatic equipment presently on the market to do just about every darkroom job from dodging negatives to replenishing short stop. Properly applied, it can enable a photographic staff to turn out prints that would suit the fussiest eyelash counter, prints that are fixed, washed and dried to technical perfection. Furthermore it's likely to put day-in day-out service on what was formerly considered a rush basis. The volume possible is enormous. The most tedious of darkroom jobs are cut out. The waste of materials and chemicals can be reduced significantly, and, as the manager of one department which has "gone automatic" said privately, the biggest reason in its favor is that "it costs less," without staff reduction and with salary increases.

While there are possibilities of great savings, the equipment itself is by no means cheap, and errors of bad planning come home to roost with a thud. In automatic-age terminology, what is demanded is a system that covers all points from lens settings to print delivery. While the machinery may amortize its costs in a surprisingly short time, in this case a surprisingly short time is likely to be a few years. A rough calculation of future work is needed to make the system pay, before the work load shifts to make it obsolete.



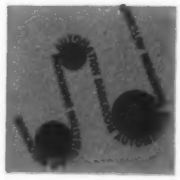
The LogEtronic system

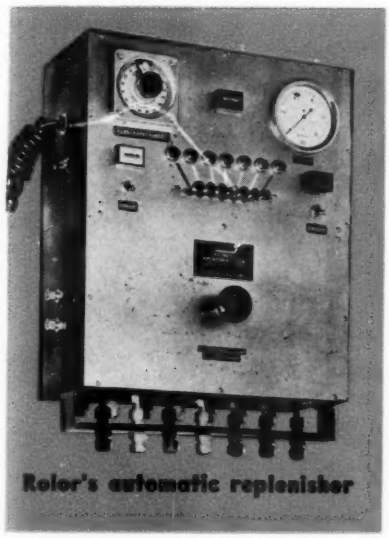
All this indicates a good deal of fact finding, experimentation, and hard thought. Some analysis by a disinterested expert is likely to be a fine investment, but these birds are rare, costly and often misused. However it is done, somewhere along the line someone has to take an objective look at the production requirements and then attempt to match them with the best methods available.

In one case cited on later pages, this task fell to the photo department manager. He reports that he felt sure that the existing means of production could be made more efficient and the work load was getting to the point where this was not only desirable but necessary. One of the most significant things he turned up when he started collecting facts was this: Printers spent 70 per cent of their printing time hovering over the developer tray waiting for the picture to "come up," so they'd know whether or not to make the print over. If a man makes only three prints a day, this doesn't count for much. But if, as in this case, he spends all day printing pictures the logical conclusion is that he's spending a greater portion of his career just waiting for prints to come up. Presented this way, it's ridiculous. The manager saw that his job was clearly to eliminate this waiting time. Through trial, error and research he found the proper ones for the particular situation and put them to work. All the results point to success.

The effort and investment necessary for a successful darkroom automation are not to be underestimated.

Automation has already taken over in motion picture processing and photo finishing installations. Now, faint stirrings on the industrial front are noted as the first items of automated equipment appear in scattered photo sections. The main problem is finding methods to turn out top quality results from the assorted types of negatives produced by industrial cameramen. This problem is being solved. Here is a look at the ways and means of automation today. The future is still anybody's guess. In the final analysis, however, the determining factor for automation will be the growth of photography in industry





Rolor's automatic replenisher

On the other hand it is possible to make an operation decidedly more efficient with commonplace techniques. It's not an all-or-nothing proposition. In many cases it can be introduced bit by bit, to grow and change with the needs of the department. One expert on the subject, Bob Silverstein, who is largely responsible for one of the most efficient portrait and commercial photographic operations in the world, Delmar Studios, Charlotte, N. C., says: "I have never been in a photographic establishment—portrait, commercial or industrial—where I have not seen an opportunity for increased efficiency." And he has evolutionary ideas in mind as well as the revolutionary, highly mechanized, continually revised system in the establishment he works for. So simple a procedure as pre-sorting negatives for contrast and density or installing a print pass-through can work wonders in cutting waste motion.

What are the means of more efficient photographic production? Well there are plenty. Many have to do with organization and layout of the darkroom. Many have to do with the attitude and working methods of the people involved. And many exist in equipment that is presently on the market. It's this last case that we'll concentrate on.

Film processing

Actually there is only one line of automatic equipment sold "off the shelf" for processing roll and sheet film, the Pako Filmachines, designed for photofinishing plants.

The least expensive unit handles 210 rolls or 360 sheets of film per hour, and costs about $8,000. It is efficient, adaptable and terribly consistent. Except for loading the film at the rates given above, and maintenance and clean up time, it operates unattended. With good housekeeping, it does a flawless job, and can be used with most popular developers.

The obvious stumbling block is the price. A very large section might be able to amortize the expense by saving a man-year of work or two but many units prefer that the photographer handle his own film processing so as not to divide responsibility for the results. What is really needed, said one photo manager, is a smaller, slower, cheaper unit.

In another photographic department, a way has been found to beat the problem. Since the outfit has its own motion picture processor, which will take up to 70mm film, the photographers splice their roll film end to end (in the dark) and feed it into the machine.

Paper processing

A single innovation in photographic printing has practically revolutionized the photofinishing industry in the past 20 years. This same idea, in fact the same equipment, is the most striking of the advances in the few industrial organizations where automation has been applied. The innovation is the use of roll paper processing. This system is superior to sheet processing in the volume it is capable of handling, in its thoroughness, in the consistency and technical (as opposed to esthetic) quality of the results.

In a very real sense, roll processing is automation. The electronically-controlled machines in the system do all the work. Print by print, they develop the exposed image for a precisely pre-determined length of time, with a specific amount of agitation, at a specific temperature, meanwhile replenishing the developer to compensate for the exhaustion of the print passing through. It gives the same individual attention to the print as goes through the entire cycle, with a degree of care no batch method could match. It never forgets to agitate in the hypo; it never sneaks a print out of the wash before it's really done. It uses the amount of chemicals and water

needed to do the job: no more, no less. It never tires. It does the same perfect job on one print or a thousand. And when it gets all done it trims the prints and stacks them neatly ready for sorting and distribution.

A number of different models of the various components for roll processing are available in the United States from two manufacturers, the Eastman Kodak Company and Pako Corporation. Although essentially similar in form and function, there are differences between the models including capacity, the method of threading the paper roll and other particulars. Operating continuously for eight hours, the capacity of these machines is from about 2500 8x10 prints per day to about double this

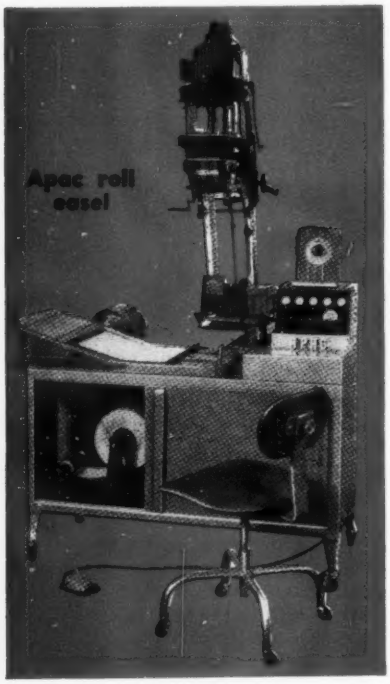


figure. The processor itself starts at about $4,000 with allied equipment bringing the total to about $10,000.

Because the processing is so nearly all-automatic, operating the machine is not a full-time job, and customarily the operator has allied duties—operating a printing unit or the sorting and disposal of print orders.

To anyone experienced with handling quantities of hypo-soaked prints of any volume approaching even half this amount, the advantage of this system is obvious. The sleeper is that the system is so systematic. Rare is the photographer who has ever been accustomed to developing prints by time and temperature. Unless the printer can call his shots without error at the enlarger, all is lost. By the time the printer finds out the picture was badly exposed, any number of negatives have passed through his hands and he must start all over again, from scratch. If the order was for any quantity of prints, a lot of expensive paper has been scrapped, not to mention the time lost.

To overcome the problems inherent in switching rolls for contrast changes, a new paper was introduced which provided a different contrast effect depending on the placement of the exposure on the characteristic curve of the paper. To overcome erratic exposure, integrated flux photometers which adjusted exposure to the negative were introduced into photofinishing printers. Adjustments in the gamma of development were introduced to make the average negative more compatible with the system. Given a properly exposed negative of an average subject, the system can work wonderfully. As far as the average photofinishing customer is concerned it is fine.

By professional standards, however, the system is inadequate. Professionals know that a creative printer can make or break a picture, and the photofinishing system offers too little leeway for the unusual case or for the occasional intentional departure from the norm.

Breaking bottlenecks

In mechanizing one large operation, the management introduced a system to overcome the drawbacks of the automatic processor. By setting and enforcing standards of lighting, exposure and development they were able to narrow down the scale of nearly all the negatives so that they could be printed on one of two contrast grades of paper with minimal dodging. In other words, the photographers worked as if they were exposing color transparencies. The negatives are sorted according to contrast and sent down a printing and processing line using the paper appropriate to the negative. Mistakes, and they are rare, are handled by conventional methods. All this makes the limitations of the system more negotiable. To get a perfectly predictable print, printers measure each negative with the on-easel probe of a sensitive densitometer and balance illumination with a rheostat so that exposure is identical in every case. The quality is superb and the percentage of rejects low, about one per cent, despite high inspection standards.

The drawback of such a system is the strict requirements for the negatives fed into it. Where strict control over the picture taking end is not possible, or where the range of assignments is such that consistency can't be hoped for some alternative is necessary.

One that is apparently successfully employed is to use it for only a portion of the work most adaptable to it. One example is cited on later pages where automation is limited to contact prints for report photographs, made full page 8½ x 11 in.

Log rolling

One recent development, however, holds a good deal of promise putting the automatic processor to work in industry. It is the LogEtronics enlarger. What the enlarger does in essence is to alter the density range of almost any negative so that it matches that of a single contrast grade of paper. For accomplishing this, the unit's designers employed two principles long known to photographic experts. They executed the principles with the help of some of the electronic technology that goes into television.

One of the principles is that of unsharp masking, a low density purposely diffuse positive replica of the original negative. In classical use, this replica is on another piece of film which is placed in contact with the original image. Being that the mask is most dense in the shadow areas, it holds back these most trans-

parent areas of the negative, "opening up" the shadows on the ultimate print. This is essentially identical to the hand technique of dodging. The fuzziness of the mask serves the same purpose as jiggling the dodging device.

In the LogEtronics system the replica of the negative is on the cathode ray tube which serves as the light source for the enlarger. A feedback device operating with a portion of the actinic light that passes through the negative enables the replica to form simultaneously with the exposure of the print. And being electronic, it is possible to change the sign of the replica, make it negative instead of positive, and thus increase the contrast of the result as in the hand practice of "burning in."

The second principle employed is that of flashing, fogging the print paper overall. Its result is to lower the effective contrast of the print paper. By using a high contrast paper, such as a No. 4 enlarging paper, and varying the relative amount of non-image light it is possible to obtain the contrast effect of any enlarging paper from 0 to 4 with an infinite number of steps between.

By incorporating these two ideas into an automatic exposure system, the makers have a system that can "interpret" any negative in such a way that it presents a standard density range to the paper. It has been characterized by the manufacturer as automatic dodging. But it is more than that. It is possible to obtain the effects of dodging with filters on a variable contrast paper, automatically.

From the point of view of the user of automatic processing equipment, this solves all the problems. With experience a printer can make an accurate prediction of the final print and trust automatic processing equipment to make the prediction come true.

There are of course disadvantages. One is the price of the system, about $10,000. Another is the fact that the light output of the enlarger is limited to the output of the cathode ray tube, a limitation overcome by the use of high-speed enlarging lenses. A third is the fact that the system is designed to be optimum for larger format negatives. The dodging is not as detailed, so to speak, for 35mm negatives as for 2¼ x 2¼ negatives. Although this does not negate the value of the enlarger for 35mm shots, it is nonetheless a factor which should be considered.

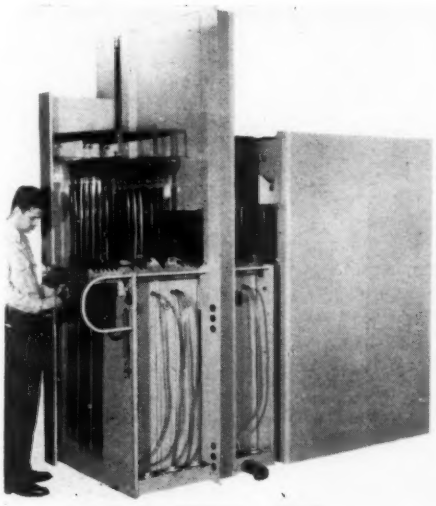
Middle road

A step short of the completely automatic roll processing that is the most popular among professional darkrooms is a device that has been in use for many years: the Pakodoper. A series of print trays is assembled on a long rocking bed. Prints are transferred from tray to tray automatically with rubber covered wire baskets that flip their contents down the line at pre-set intervals. It is designed to handle the "back end" of print processing from short stop to wash; the developing is handled by conventional means. As a chore boy it is truly a wonder.

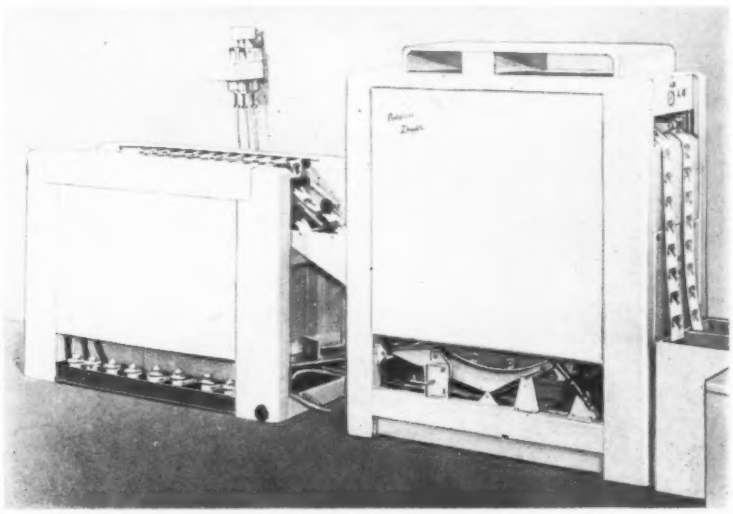
To get full value from an automatic darkroom system, some sort of quality control system is needed. The most widely used, and its use is really not wide enough, is a testing kit offered in the U.S. by either Kodak or Ansco. A precisely exposed test emulsion is sent through the line and then closely evaluated for failure or sub-standard performance in the system.

This is not the end by any means of automatic or semi-automatic equipment for darkroom work. Equipment manufacturers offer mixers, storage tanks and pressure systems for piping in chemicals, nitrogen burst agitation systems, static eliminating devices, densitometers, print meters that control enlarging time, print numbering systems, print baskets and reel holders, washers and driers.

Automatic devices can be a waste of time and money if misapplied or misused. On the other hand, the efficiency obtainable with one is a wonder. Because of the stumbling block of their radical departure from usual procedure and the high initial costs, it is likely that there are more errors in omitting them than in commissioning them. But let the user be forewarned choosing a system for his operation demands study. A good start is a trip to a photofinishing plant, whose operators are way ahead of the rest of the photographic industry in adopting automatic techniques. The second step, collecting literature on the automatic equipment available is made easy by suppliers who are not the least obscure on the performance of their products and most cooperative in supplying literature.—THE END



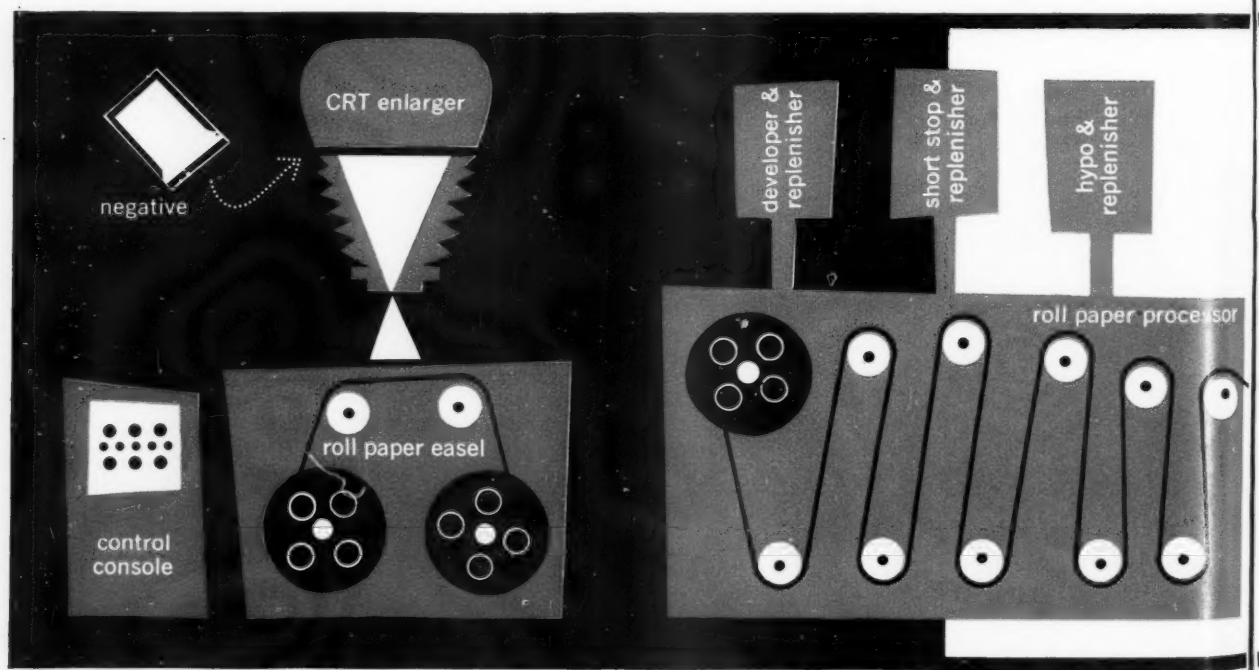
Pako film machine



Pako paper developer and dryer

CATERPILLAR TRACTOR CO.

The makers of world-renowned Caterpillar machines were one of the first manufacturers to recognize the value of top-notch photography in helping to sell machines. Now they're one of the first outfits to utilize automatic equipment in turning out high quality photographic prints in volume. Production of 8 x 10 prints runs upwards of 400 prints per hour —and service is on a 24-hour basis, with rejects and paper waste at a new low. Ed Farber tells how Caterpillar's high-efficiency system works



A picture-conscious corporation with production-conscious management and a soul-searching section head has pioneered one of the most highly automated industrial photographic departments in the United States.

Caterpillar Tractor Co.'s new twenty-eight-man Photocopy and Duplicating Section headed by Ed Andrews has just completed the installation of a new photo lab which is capable of making 8 x 10 enlargements at the rate of 400 or more an hour . . . and, to quote Andrews, "with hardly a reject."

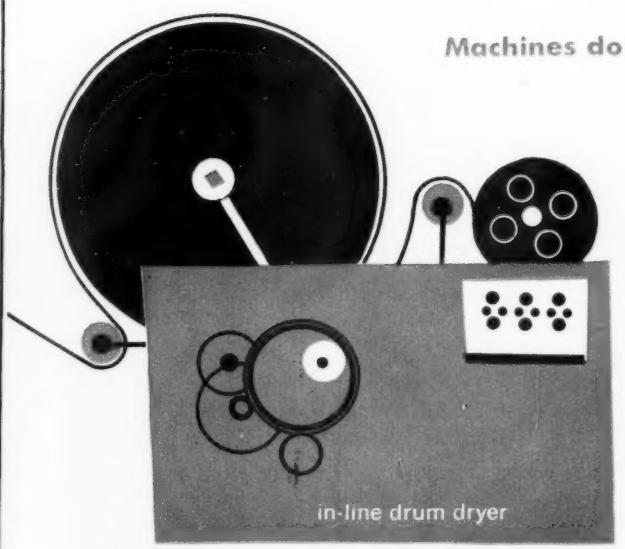
Caterpillar was one of the first to embrace equipment-at-work photographs to convince customers of the stamina and earthmoving capacity of their products. Many will recall the dramatic photos that Caterpillar started using some thirty years ago in the *Saturday Evening Post* ads.

The use of such photos grew and grew, and today negatives from company photographers and selected professionals stationed in almost all parts of the world flow into the Peoria lab to be developed, numbered, printed and filed for use. The prints are made available for advertising, promotion, engineering, service manuals, dealer manuals, press releases, text books, lectures and wherever and whenever the organization can put them to good use.

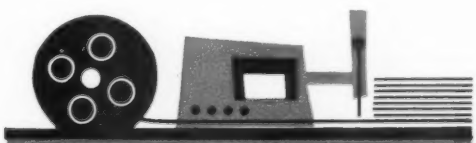
As volume grew over the years, Andrews became increasingly aware of the limitations of their processing procedures. He wanted speed. He wanted to give 24-hour service. He wanted to give 3- to 4-hour service on emergency news pictures. He wanted to continue to give the high quality for which the section was noted. He wanted to continue to give prints with shadow detail so features of a machine could be shown to customers. He wanted to continue to give prints that would have highlight details and a range of tones that would guarantee good reproduction in newspapers or catalogs. He needed prints that would match when used in layouts or parts manuals. He needed these prints in quantity—sometimes hundreds from one negative. He needed to do all this without the extensive use of overtime, farming out the work, or the use of temporary help, even though the demands fluctuated.

Andrews, who majored in fine arts at Peoria's Bradley University, had a background of military photography, worked in Hollywood studios for a couple of years on a rear projection stereo system he devised, and had almost ten years of experience at Caterpillar. A man given to facing realities squarely, he decided to see what problems he really faced and just what he might do about finding solutions for them.

Machines do the work, but people have last word



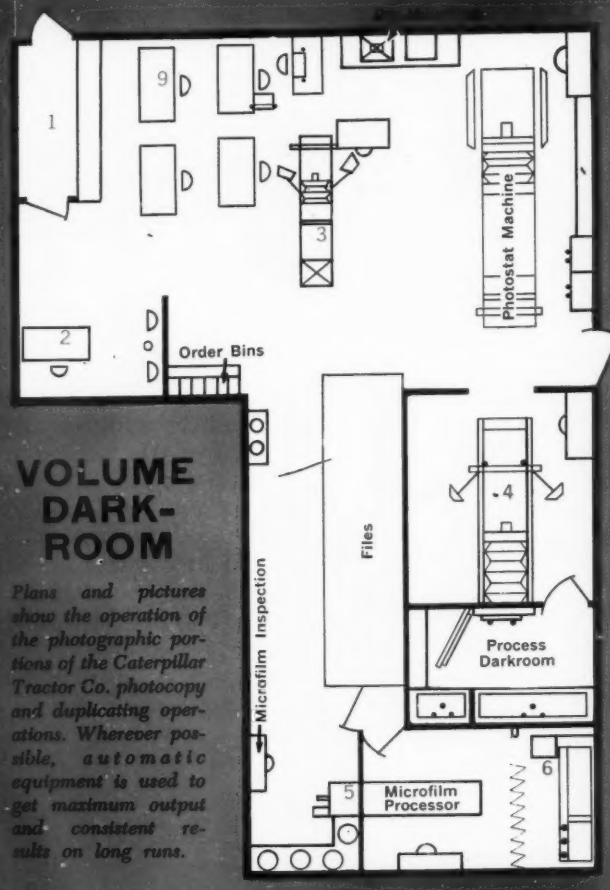
in-line drum dryer



Caterpillar's print system practically eliminates manual handling. Chief elements are electronic enlarger with roll paper easel, in-line processor and drier, mechanized paper trimmer **(above)**. The system rests on human judgment in reading negatives and sorting prints.

VOLUME DARK-ROOM

Plans and pictures show the operation of the photographic portions of the Caterpillar Tractor Co. photocopy and duplicating operations. Wherever possible, automatic equipment is used to get maximum output and consistent results on long runs.



Non-automated print room with Omega and Saltzman enlargers, Peko dryer is shown above. Automatic print operation is at left. Canvas light traps are indicated by wavy lines.

Technicians advise "customer" to solve problems. **(1)**

Photographer Charles Butler at A.T.I. camera. **(3)**

The dryer end of the E.D.L. 35mm Processor. **(5)**

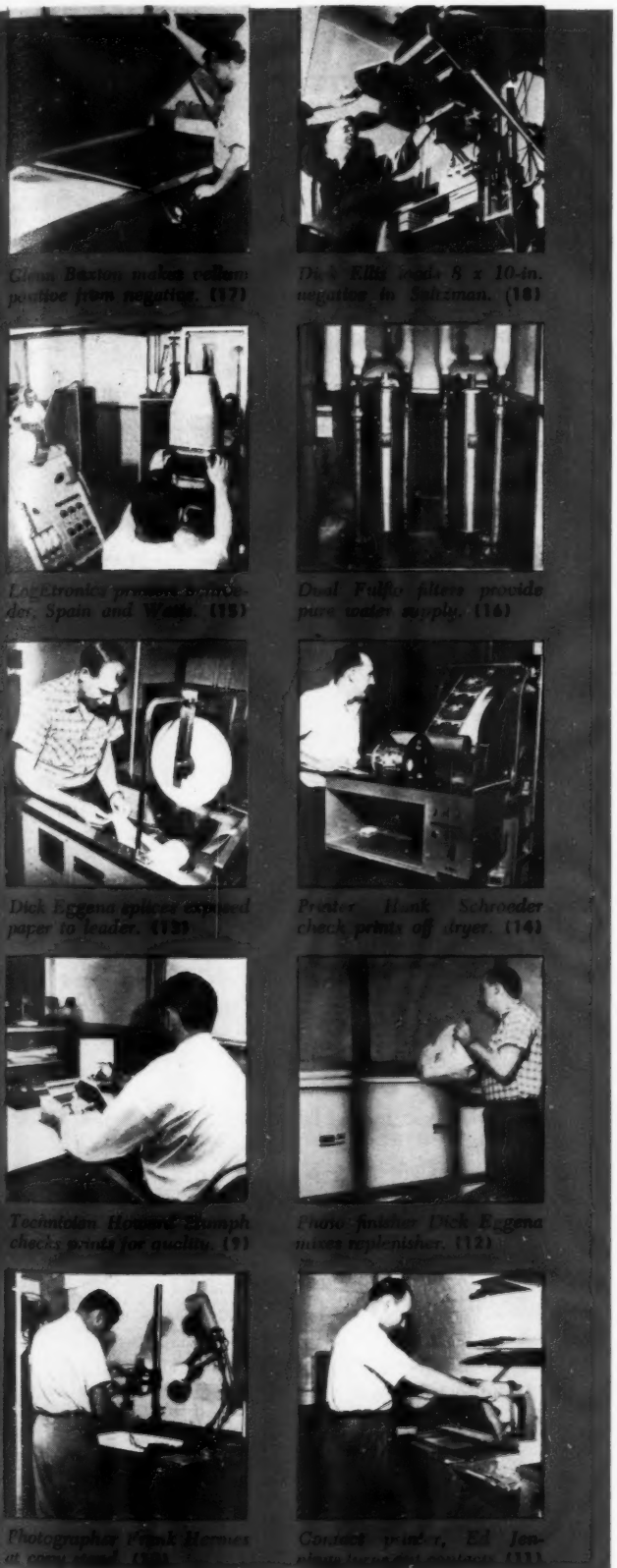
Kodak 30E Electronic Cutter trims finished roll. **(7)**

Boss men C. M. Tiffan, J. R. Kolditz, E. W. Andrews. **(2)**

Tom Cartwright makes paper negs on Photostat. **(4)**

Dick Baird prepares to process pan film. **(6)**

Finisher Jerry Smith sorts orders after trimming. **(8)**



He discovered that his printers (those doing the enlarging) were "spending about 70 per cent of their time developing prints," an ineffective use of equipment and manpower. He tried the use of separate "print dopers" to permit a skilled printer to keep printing, but this was not considered successful. The man on the enlarger still had to watch the developing print to some extent to see how he was doing, and the divided responsibility made the production of quality work more difficult.

Exposure meters of two brands were tried on the enlarging easels, but timing the dodging was too time consuming and did not remedy the production problem. Making copy negatives of good prints and even masking the negatives were tried. These were also unsatisfactory. Processing machines were still not practical under the circumstances at the time.

Certain that the solution lay in some sort of controlled printing, Andrews urged his boss, J. R. Kolditz, Manager of Caterpillar's Office Services Division, to accompany him to visit the plant of LogEtronics in Alexandria, Va., to investigate what their machines could do. "They would have to convince me," says Andrews, "and they did."

Both men liked what they saw and the philosophy behind the machines as well. LogEtronics took pains to point out that their "enlarger is no substitute for knowledge and experience. The LogEtronic enlarger will only do what the operator tells it to do." "But," points out Andrews, "the machine does produce a predictable result." One problem remained to be solved. Andrews had determined that "the only practical way was to print onto a roll," if he was to get the required production. He discovered that the Eastman Roll Paper Easel could be built into the base of the LogEtronic enlarger and wired to its controls. Then the printing could be done directly on 500-ft. rolls of 8-in. wide paper and hundreds of prints handled as a unit.

Now most of the tools were at hand. Andrews presented a carefully documented case to management—and waited. Finally his detailed report came back—having made its way as far as an executive vice president—approved.

He promptly ordered three LogEtronic B5 4 x 5 enlargers with Schneider Xenatar 3.5, 5¼-in. and 2.8, 3¼-in. lenses; three Eastman Master Roll Paper Easels, No. 1; one Eastman 4A Processor Dryer; and one Eastman No. 30 Automatic Paper Cutter.

A new area had been found for the photo copy section making the transfer and installation somewhat easier. Andrews resolved to "move a single

function at a time" to avoid interrupting production.

Moving was accomplished during regular hours, and with no need for overtime. A few unforeseen problems arose. The process camera would not go down the stairway or into the freight elevator. The elevator was finally parked between floors and the camera lowered through the shaft. A pit had to be dug in the floor to give clearance to remove tanks from the microfilm unit in a low ceilinged room, but all was accomplished without incident.

Well lighted, clean and sparkling, the department and the personnel reflect a competent and businesslike operation. Representatives from other departments fill in numbered request forms for prints and services. Forms are numbered for record purposes only. There is no charge back to other departments. Counter personnel are familiar with all procedures and methods of reproduction so they can recommend the simplest and most effective process.

All negatives are numbered in the picture area and are filed by number in the photo department. All prints are requested by number. If cropping is required, it is indicated on the contact print or the transparent envelope from which the requested negative number was obtained.

Orders and negatives are turned over to one of the three LogEtronic operators. They examine the negative, put it into a negative carrier and bring it to size and focus. Readings are then made with two probes that are placed on the easel to read highlight and shadow areas selected by the operator to obtain the amounts of whites and blacks that will give the desired pictorial rendition. Three meters indicate the readings of the probes as highlight, shadow, and the (reciprocal of) exposure time. When all three meters read the same, a normal or average print is obtained. However, the operator can adjust these readings to obtain whatever amount of burning in, dodging, or total printing time he desires.

A control is set indicating the number of exposures desired, the focusing cover is flipped up from the easel, and the sequence of exposures is initiated by pressing a button. The required number of prints are exposed, dodged and timed au-

The quality? It is perfect

How does the quality of prints obtained with the Caterpillar system stack up with conventional professional processing? Photo Manager Ed Andrews emphasizes that quality rests with the man and not with the machine. What the system provides the darkroom man is a way to get predictable results at the enlarger, and thus permits high-volume mechanized development. The aim was to keep up the previous level of quality and increase service while reducing cost. PMI author Ed Farber observes that the quality standard at Caterpillar is high indeed, and well-suited for the intention of the photographs. Caterpillar's usual objective is to display the equipment and its habitat in unambiguous detail. In a typical example, the scene depicted in the pictures at the left, Caterpillar wishes to leave no doubt that this is for real; the machine does leave no stone unturned. The picture was made in bright, direct sunlight — and the enlargement *(opp. right)* retains the sparkle of the original scene brightness. The contact print *(far left)* also gives this impression. A closer look, however, reveals that the enlargement has something the contact does not: the compensating dodging in the shadows and "burning in" in the highlights, that brings out their detail. This is a feature of the automatic masking and flashing of the Log-Etronic enlarger used in the system. Details from the two prints—straight contact and automatic enlargement—shown here illustrate the point. The enlargement holds detail in the highlight areas, areas which are washed out in the contact. In other words, any detail that's in the negative is going to show up on the print. In Caterpillar's case, this means a nearly perfect print every time. Where subjective interpretation is important, say in fashion work, Farber believes the standard of quality might be too perfect for the taste of some. Naturally, if a printer wants an abnormal quality print, he can get it.

Automatic (above) *straight print* (below)

tomatically. At the end of the sequence, the operator flips down the focusing cover and prepares the next negative.

At the end of any printing sequence, the exposed prints may be cut from the roll of F4 Medallist paper which is used on all prints and cut from the roll by a built-in cutting device. It is then put into a pass through to the developing room adjacent. Here the Eastman No. 4A Processor takes over and produces dried prints at the rate of 6½ ft. a minute.

The roll of prints is then run through the cutter which electrically detects the proper cutting point from a conducting graphite spot put on by the easel at the time the paper is advanced. Prints are then sorted and sent to an inspector-expediter at the front counter who first received the order. Here the prints are checked for quality, wrinkles, gloss, count, size, etc. against the original order and packed for pick-up.

Since his operation is scarcely under way, Andrews is unable to completely evaluate the success of the installation, but typical of the kind of service that can be given was an order for ten 8 x 10 prints of 18 different 4 x 5 negatives that came in at 11 a.m. while this reporter was at hand. The prints were ready and inspected by 2:30 p.m. that afternoon, a full hour ahead of the requested deadline and with no upsetting of normal routines.

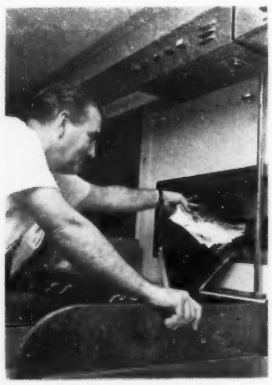
Andrews emphasizes that practice and skill are needed by the operator. He was also lavish in his praise of the LogEtronics people who twice sent instructors to work with the Caterpillar staff. He felt that some prints still lack crispness, but that almost always "prints were at least as good" as could be achieved laboriously by other methods and that many other types of prints were impossible to dodge by hand under any circumstances.

Queried about service problems, Andrews felt that the presence of a trained electronics man was a boon, and helped to immediately locate an occasional bad tube "just as you have in your TV set." However, he pointed out that the modular design of the units which permits substitution of inoperative tubes by plug-in replacements which are shipped from the (*continued on page* 51)

MECHANIZED

RUSH

Speed's the thing at United Press International headquarters in New York. Nobody has time to count the daily avalanche of prints, but it numbers in the thousands. Here's how UPI plans to offer better and faster service with mechanization



UPI printers get an assist in rush work with automatic equipment including roll easel, push button sink, motorized pass.

Outside darkroom, 16 electronically controlled devices pick up fixed prints for bath, hypo-neutralizer, and wash.

Electronic enlargers automatically compress or expand tonal range of prints to match high-contrast roll paper in easel.

Rotary dryers are for pre-cut sheets; in-line dryer, background, handles roll processed work. Pigeon holes sort prints.

Until recently, the headquarters of United Press International news pictures was a sooty composite of a set for *Front Page* and a beanery kitchen. UPI directed its global photo communications system from a hypo-caked, unwashed floor of a building in New York City's garment district. There had never been a maintenance shutdown because UPI never closed—and it showed it. Cypress sinks had accumulated decades of slime. Prints were often so crowded they stacked vertically and fell over the sides of the wash tanks. Printers chipped in to buy fans to stir the hot summer air made thick with the vinegary smell of photo chemicals.

This year, with the acquisition of space across town in the modern *Daily News* building, UPI did a complete turnabout. For the first time in years there's elbow room, and even expansion facilities. Everything imaginable is automatic—from the air conditioning to floor mats which ring a buzzer and stop the machines if a picture editor absently wanders too close to a hypo basket about to flip its prints into a stainless steel washer.

When charged with acquiring any new equipment necessary for the move Bob Ellis, UPI assistant director of personnel, checked prices on everything from cypress sinks on up. He also suggested that suppliers study the operation and recommend any process changes that might fit in to advantage, whatever the cost. When he assembled a plan, it turned out to be the most expensive, and most efficient solution he had listened to. Scrutiny by Ellis, Harold Blumenfeld, executive picture editor and Frank Tremaine, UPI vice president and general manager in charge of news pictures, revealed that labor, expansion and space costs made it the least costly answer.

In the midst of the nominating conventions, UPI moved to its new headquarters. In a hectic transfer, with photo librarians pulling negatives from boxes in the arms of truckers, the daily avalanche of print production kept on full blast. Some new equipment still awaits delivery, but for the most part, the automatic darkroom is operating.

UPI handles two kinds of work: rush and accelerated rush. If a print can be handled leisurely, as much as a day or so might elapse between an event in Cairo, Egypt and delivery of a print to Cairo, Illinois. In a fast developing crisis, however, this time must be shaved to minutes.

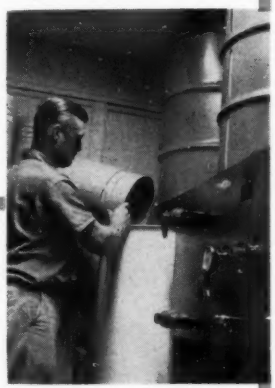
The work methods for making prints are likewise divided into two classes. One is fully automatic. It handles a remarkable volume of normal work. The other method is semi-automatic, a necessity when the pressure is really on, and a print must be untimely ripped from the wash and sizzled on a flat bed dryer.

The fully automatic section comprises two LogEtronic enlargers equipped with Kodak roll paper holders and a Pakoline Prosser with an in-line dryer. An automatic print trimmer will eventually be attached to the end of the line, but at present prints are cut apart by hand after processing. Daily capacity of the processor is high, perhaps 10,000 prints on three shifts, but at present some of this is "in reserve" because the prints are not exposed as quickly as the machine can handle them.

In the semi-automatic section, there are 16 printer stations side by side in a 100-ft. darkroom. Each printer is equipped with a 4 x 5 Omega, usually mounted on a moveable stand. Except in the case of stations set up for Telops, large blow-ups and special work, each printer has an Apac roll paper easel. Varigam paper in rolls is used; prints are cut apart after exposure. Once the printer has chosen his filter and ex- (*continued on page* 75)

Short Deadlines, More Handwork

UPI could be more efficient than it is—except every minute is a deadline. These pictures show the equipment used for rush runs up to 100 prints or so. The roll paper easel *(far left)* automatically exposes any number of prints once contrast filter, focus, and exposure are set up. Prints are cut apart and developed in sink section *(center)* equipped with push-button controlled developer spout, intercom and other refinements. Pass through accepts fixed prints, drops them into automatic rinse, hypo-neutralizer, and surge wash tanks *(immediate left)*.

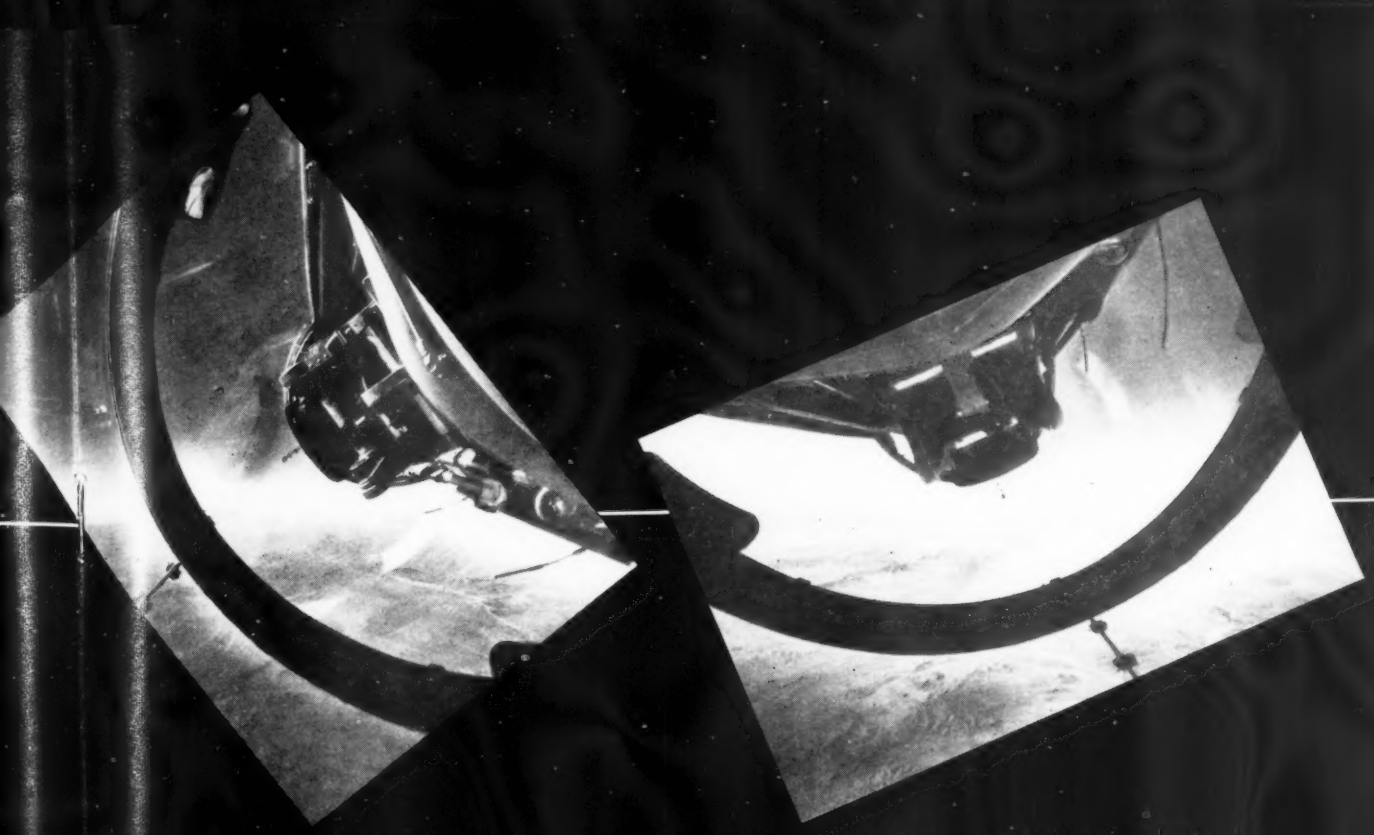


Central chemical room

Full Automation Ups Volume, Slows Service

The fully-automatic section is capable of a larger volume of prints per man, but doesn't compete with the semi-automatic method for prints on short deadline. It comprises two LogEtronic enlargers with roll easels, a roll processor, in-line dryer, and eventually will be equipped with an automatic trimmer which cuts prints apart where marked by easel. Picture at left shows automatic darkroom. Output is seen in center background of picture at right. Chemical room serves both systems.

A
SLOW
ROLL



After twenty years of banging out pictures of planes and pilots, Lockheed's crack PR photographer, Bill Miller, still gets excited about anything that flies. He says, "I had to dream up an excuse to get a ride in our F-104, my first in a REALLY hot fighter." He promised a picture story, saw it while riding aft in a two seat version of the "missile with a man in it": the pilot's flawless execution of a snap roll in the record breaking 1,400 mph fighter. Miller got the pilot to slow the roll so he could keep the film knob turning as fast as the horizon (white line). Nikon, 21mm Biogon, Panatomic-X, f/10, 1/250.

ASSEMBLY LINE COPYING

Special equipment, scientific management and exacting quality control over every step in the process enables Polaroid's Copy Service to meet the growing demand for high-quality, low-cost copies in a hurry

Back in the dark ages, as Polaroid time is reckoned (about 1949 on regular calendars), the 60-second camera was beginning to win increased acceptance except among certain people. These unbelievers in progress pointed out that there was no cheap, easy, practical way to get duplicates of priceless snapshots because there was, to put it delicately, no negative. Also, copying photographs has long been considered a long, slow process with an annoying tendency to grey highlights. The answer to the problem of duplicate prints was the establishment of the Copy Service a little over a decade ago. The answer to the second was the establishment of rigid quality controls, plus a policy of continued research by Polaroid laboratories.

The first copies were made using direct positive paper. Within six months after plans for the Copy Service, a satisfactory chemical reversal process was worked out and the necessary automatic copy cameras and processing machinery developed. By June 1950, thousands of copy prints were made daily.

During this period, research continued seeking a suitable negative copy process. In discussing ideas with Polaroid suppliers, it was learned that Kodak was doing work on a similar problem, developing a special negative material for high grade copy work. This film was Kodak Ortho-Copy (also called Gravure Copy). Polaroid became the first large user of this material.

In addition to the film, special equipment was built and a system developed which reduced handling time per order to a few hours. Today, most orders are mailed back within 24 hours after being received at Polaroid in Cambridge. This speed was established without sacrificing quality. This was an important aspect of the problem since customers could compare the copy print with the original.

Currently, Polaroid Copy Service offers copy negatives, same-size copies, 5 x 7, 8 x 10 and 11 x 14 enlargements. Before being mailed back to the customer, each order is inspected by a group of trained girls who also send back a Tip Sheet, a little sheet giving a remedy for any defects noted in the original order.

Although the system provides speed and efficiency, it is the rigid sensitometric controls which insure a high standard of quality, which is remarkable considering the tremendous volume of prints handled by the Copy Service at Cambridge.

Each copy negative is exposed under identical conditions. This exposure must be determined by the quality control laboratory for individually matched batches of negative emulsion and paper.

Each copy negative includes a control patch alongside the picture which, during printing, automatically times the printing exposure to fit the overall density of that negative. The only time changes are made is when the copy camera operator indicates that the copy is to be printed lighter or darker than normal. This is indicated by a number which appears on every copy negative, set at the copy camera.

In determining exposure, a General Radio 1501-A photoelectric meter is used. It not only measures density but the product of exposure time and light intensity. The reading is taken from the film plane to avoid exposure error.

Each roll begins with a shot of the standard test target. This includes a light, normal and dark portrait of a baby for quick visual checking, plus a grey scale to indicate tone reproduction for the H & D curve. The ideal curve has a straight line at 40° to the base with some increase in density at the upper end of the scale.

The copy cameras, built by Polaroid, permit a 3-sec. operating cycle of loading, exposure and unloading. Turning the three-sided platen actuates the exposure mechanism, contact points being located at points 120° apart. An operator can process 100 orders an hour.

Kodak 70mm Ortho-Copy film is used in 100-ft. magazines, with a capacity of 320 2¼ x 3¼ copy negatives. A synchronous motor drives the before-the-lens disc shutter which gives an exposure variation of less than 2 per cent. The lenses are f/9 Artar. Illumination is provided by two reflector floods which are on at all times but are overloaded during exposure for increased brightness.

The exposed film is processed in a Polaroid-built processor, developed in Durafin for two minutes to a gamma of .4 to .5. Film is handled at a rate of 15 ft. per minute.

Densitometric readings are made of every roll of film from the test picture. The normal reading, taken from the upper end of the scale, is 1.5 units, plus or minus .05.

Pakomatic and Velox Rapid Roll printers are used for the same-size

copies and the 5 x 7 enlargements. These printers were modified by Polaroid with a special film gate and a photo electric cell which can read an area ⅛-in. square.

Regular Beseler enlargers are used for making 8 x 10 and 11 x 14 custom prints. These prints are also spotted by hand before being shipped to customers.

Papers used include Velox Unicontrast for regular copy prints, Jet GL 3 for 5 x 7 glossy prints, Polycontrast Rapid N for customer prints and Christmas cards for the holiday season. Paper developers are Kodak Duomat and Hunt H-8. Temperature is kept at 70° ±2°.

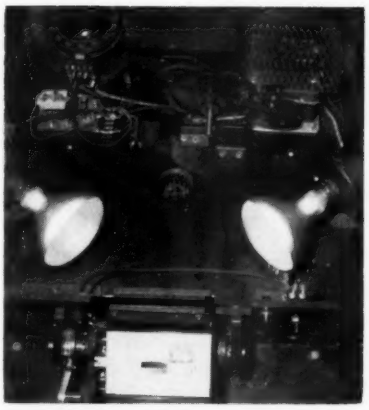
Incidentally, if the phrase Polaroid-built tends to crop up, it is not a typographical error. A fully-equipped machine shop is maintained to help develop special equipment needed for the Copy Service operation, an important factor in maintaining high standards and low costs. Quite often, it is possible to get a copy which shows more contrast and detail than the original. However, it was decided that any improvements would be kept to a minimum after customers complained that they would have made "normal" prints if they had wanted them. Now, Copy Service aims for faithful reproduction.

Services rendered by Copy Service are not always technical or photographic. There is one case on file where a woman who bought some surplus stationery supplies from a Texas army base found a battered envelope with prints from Polaroid addressed to an officer stationed at the base. The envelope was seven years old.

The woman felt that these pictures may have had value for the officer and returned them to the base, only to be informed that he was no longer stationed there. She then mailed the prints to Polaroid's Copy Service who sent a letter to Washington asking the present whereabouts of this officer. Back came a letter asking for $1 to look up the files. Polaroid sent the dollar, got the present address and sent not only the original prints but two new copies of each print.

An interesting, though not technical, sidelight on the Copy Service operation is the photo school conducted for the girls who work in the department. It is an eight-week course, one afternoon a week, in basic photography. The feeling is that if the people know something of photography, they will be able to handle the problems of Polaroid's customers with a little more understanding. This course is given in addition to the training in printing given to people assigned to printing custom prints.—THE END

Steps in the process from original Polaroid print to copy



Special Polaroid-built camera uses Artar lens, 70mm Gravure Copy film.

Original print is placed on easel, revolved to face lens inside camera.

Test print is photographed at the start of every new roll of film.

Densitometric tests of each roll made as soon as processing is done.

Original photomicrograph was made using Polaroid back of view camera.

Copy Service print. Compare with original for tone value, fine detail.

ONE MAN AUTOMATION

The monthly print order at Hanford Atomic Plant averages 20,000. It takes 11 cameramen to fill this order but only one man, using automatic equipment, to print almost half this order

In the America of 1960, industry is news, especially that part of industry dealing with defense and atomic energy. Typical is the Hanford Atomic Plant, Richland, Wash., operated for the AEC by General Electric as a prime contractor, producing plutonium.

News, of course, means pictures. These are supplied by a 14-man section (one of whom, using automatic equipment, can produce up to 1200 prints a day) as part of the varied assignments which keep Hanford Photo Operation in business. Besides news, Hanford photographers shoot everything from ID photos to aerial views of the 600-sq. mi. installation.

Photography at Hanford, however, has an added element; the danger of radiation. Quite often, both photographers and cameras have to be swathed in protective clothing while on the job. Bob Clemensen, a photo group leader, characterized this system as "photography while wearing boxing gloves."

The Photography Operation is headed by Charles Brewer, manager, who started photography at Hanford as a one-man operation 13 years ago. There are two labs; the 300 area lab located in one of the research and production areas of the plant, and the 700 area lab, in the city of Richland at the administrative area. Four photographers and a technician are in the 300 area group while Brewer, seven photographers and a clerk are in the 700 area. The two groups are about 30 miles apart.

In addition to photographic work, the section provides advice on photography, purchasing and processing for non-photo people who do limited amounts of specialized photography.

Because the range of assignments is so great, Hanford photographers must be able to handle a variety of equipment, ranging in size from 35mm Leicas, Retinas and an Alpa, to Rolleis, 4 x 5 Graphics and Linhofs and an 8 x 10 Linhof. There are also a variety of specialized cameras including a K-20 aerial camera adapted for use with roll film, a Graflex with 14-in. telephoto lens, high-speed cameras and a Robot with electronic flash used to photograph the interior of radioactive waste storage tanks. There is also a small press camera adapted for taking pictures through a periscope.

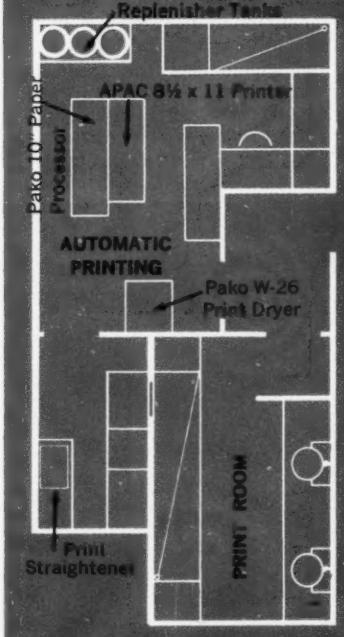
A unique item is the "camera-on-a-pole" used to photograph the interior of storage tanks. An old copy camera adapted for use with 2¼ x 3¼ roll film, it was mounted on the end of a 12-ft. pole. Also mounted on the pole is a reflector for No. 22 flashbulbs. The camera is covered with plastic shields to protect it from radiation.

In use, the camera is raised and lowered each time a picture is made to permit replacing the flashbulb. When eight exposures are made, the plastic is cut away, the film changed and a new plastic cover applied.

Unusual, from the point of view of the in-plant cameraman, is the national audience for many photos made at Hanford. A story on burial of atomic wastes ran in *Life* while another photo was

(*continued on page* 50)

APAC automatic printer *(above)* is in 300 area lab *(below)*.



Basis of automatic printing is 8 x 10 neg made by copy camera.

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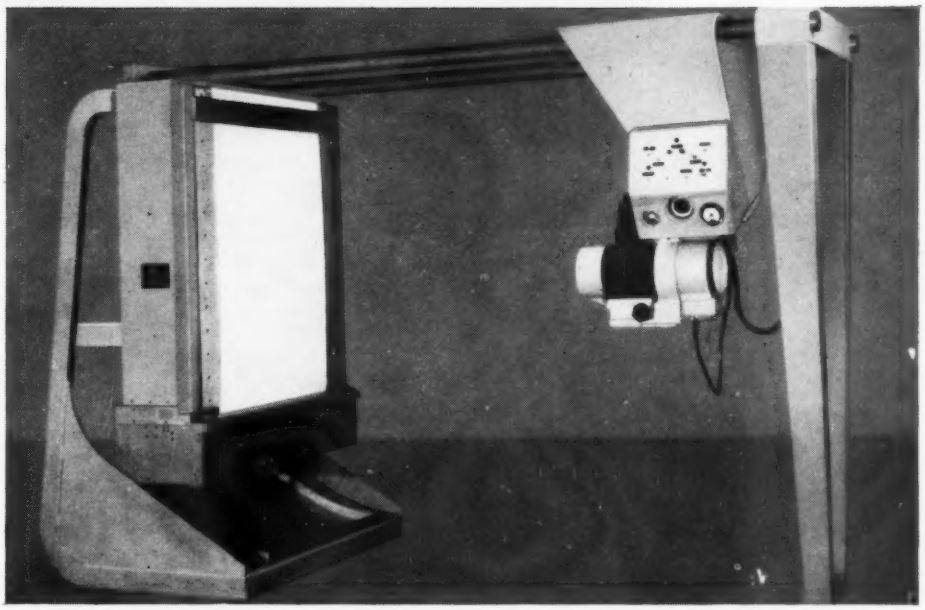

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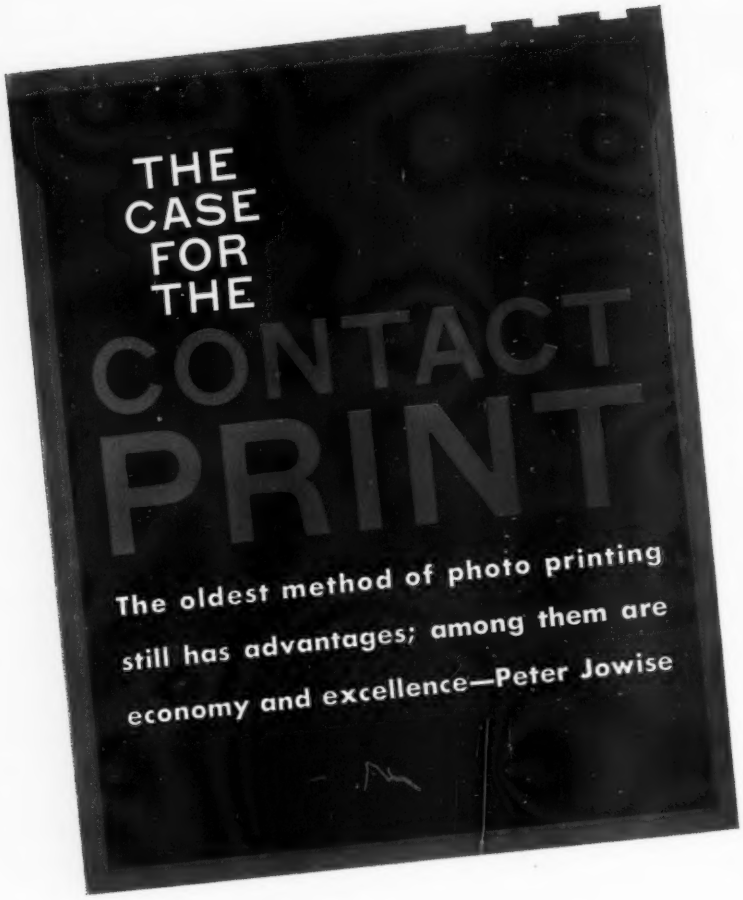


The end result of much of the industrial photographer's labor is a photographic print. The print is normally made either by enlargement from the negative, or by contact printing it. Too frequently this choice is based on the emotional desires of the photographer: we have the large format group, the small format group, the miniaturists, and others. In the heat of its enthusiasm, each group may be convinced that it has found the universal and only satisfactory answer to print production.

This would seem to be about as valid as the stand taken by the commuter who has to get to work each day as inexpensively and yet as comfortably as possible. He buys a Volkswagen sedan. It completely satisfies his commuting needs, and this leads to a heated love affair with it. He becomes a Volkswagen booster, unsympathetic to other points of view—and almost totally blind to the usefulness of other cars. Then on the weekend he stuffs his family of four kids and a wife into the same car that he commutes with, to take them for a 200-mi. trip into the country.

For what uses of photographic prints should reproduction be made via enlargement? What uses will permit us to choose contact printing? (Permit, because from every quality consideration, contacting is the preferred technique.)

An enlarging or reducing device should be used only when it is not possible to make the photograph in the camera to the size of the desired, finished print. Such uses include exhibition prints, prints that will be used in layout work where the photographer is not always sure of the size to which the art director is working (in layout, size may be very large, and quality is a secondary consideration), and reproduction in various sizes from a single negative.

The contact print, on the other hand, can and should be used whenever the print produced from the negative can be used in the size in which it was made.

Before considering the relative quality of enlargements and contacts, look at the matter of costs of production. For the making of one, or a few prints from one negative, there doesn't seem to be any advantage to either technique cost-wise. Exposure, processing, test-printing times are essentially equal, as are material costs. When quantity prints are considered, however, the pendulum swings over in favor of contacting. It swings way over in those cases where differential exposures, dodging and burning-in are required.

Differential exposure is obtained in contact printing by inserting tissue paper masks between the negative and the light source. Once the dodging set-up has been made properly for a print, any number of identical prints can be readily produced. Even a highly-skilled operator would have difficulty working to this sort of accuracy in enlarging.

Contact exposure times are quite short and should be controlled by some automatic device. The time saved, compared to enlarging exposures, can be several man-hours per week in quantity production. Compare, say, a 10-sec. enlargement to a 1-sec. contact exposure on just a few hundred prints a day. At the Shell Development Company, for example, our printers were able to set-up, test print, expose, develop, stop and fix as long a run as 100 8 x 10 contacts in about 30 min., using ordinary equipment.

Quality, like love, being a many-splendored thing, resists simple definition—yet we can point out some salient features of quality applied to the photographic print. Three of these are: the reproduction of any fine detail that exists in the original subject; the reproduction of the tonal gradations of the original subject (within the limitations of the photographic process); the reproduction of the perspective relationships.

The reproduction of fine detail in the negative depends on the resolution of the lens-film system and the acutance of the film. The latter has no direct bearing on the present question, since the same film can be used for contacting as for enlarging. Resolution is, however, a direct concern.

Consider the following argument. We want to make an 8 x 10 print. We make a negative with a lens-film combination which will just resolve 40 lines per millimeter. If we are working onto 8 x 10 film, then we expose our negative onto the print paper with a resolution practically equal to that value. On the other hand, if we are making a 4 x 5 negative, we must enlarge it two times to put it on an 8 x 10 print.

Obviously we will end up on the paper with fine detail discrimination equivalent to an original camera resolution of only 20 lines per millimeter. This includes the extremely hopeful assumption that the enlarger lens is perfect.

In producing a 4 x 5 smaller negative, a lens-film combination with twice as great resolving power is necessary, to retain the same fine detail as with an 8 x 10 negative. Naturally an extension of the same argument holds going from 4 x 5 to 2¼ x 2¼ and on down to 35mm.

In addition to loss of fine detail due to resolution failure, the enlargement also tends to lose gross detail, in the shadows, due to the inevitable flare illumination accompanying enlargement.

Flare illumination is non-image-forming illumination falling on the print paper.

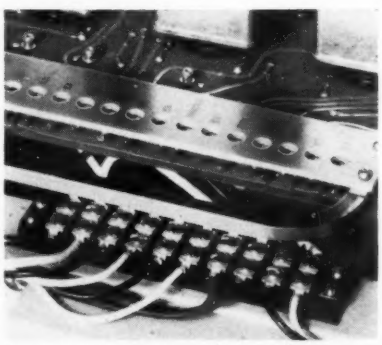
This flare light may come from ill-designed optics in the enlarger itself, from the operator in the darkroom, and from bounce light from the walls and surrounding objects. Supposing that the negative is matched to the print paper, this non-image illumination has the unfortunate consequence of producing a general fog over the entire exposed paper surface. The result is a darkening of the highlights which have received very little image-forming exposure through the negative (and hence are quick to show the effect of very little additional exposure). Furthermore, flare results in a loss of subtle tonal gradations in the shadows, where blacks and almost-blacks should delineate shadow details. The almost-blacks become black, and good-bye shadow detail.

A well-designed, pure condenser enlarger will minimize both the flare problem and the problem of loss of resolution already mentioned. At its best, such an enlarger produces prints that compare favorably with contact prints. It suffers however from one grievous fault. It is notorious for reproducing little bits of dust, lint and dirt with exquisite fineness and accuracy. In the case of the contact print these are also reproduced, of course, but they are reproduced at the size in which they exist.

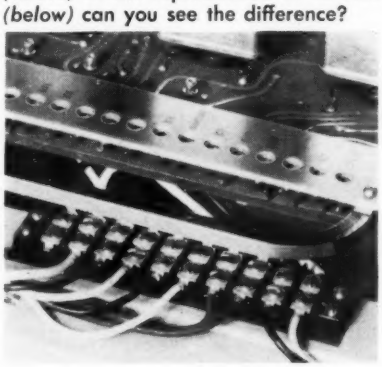
With regard to perspective (which should receive far more attention than usually accorded it) the 8 x 10 contact exhibits a very realistic appearance. It normally is held in the hand and viewed from a distance of perhaps 10 or 12 inches—the so-called normal reading distance. Usually it has been made using a lens with a focal length somewhere between 9 and 14 in. The viewing distance from the eye to contact print closely approximates the original lens-to-film distance in the camera. This means that the angles subtended at the eye by the objects as seen in the photograph are in the same relationship to each other as were the angles subtended at the lens by the objects themselves as they actually existed. The perspective is correct, and the picture looks more real, more plastic, more three-dimensional than it would under any other circumstances. Try it yourself, if you have not done so already, and see.

This same effect can be obtained with *any* format film, of course. It is necessary only to make the original photograph with a lens of a focal length commensurate with the final viewing distance of the contact print, or to make an enlargement to the proper magnification.

On the other hand, if one intends to make contacts, it is sensible to use a longer focal length lens. At Shell Development Company, whether using 4 x 5 or 8 x 10 film, our standard workhorse lens was the 9¾-in. Dagor. This is more lens than one needs for the 4 x 5 format, since it very nicely covers the 8 x 10. With sufficient bellows draw on the camera, there is no reason why it should not be used, even for the smaller format. It was our frequent practice to do so. In such a case the 4 x 5 print, viewed from the normal reading distance gives correct perspective relationships.



Same-size engraving from enlargement *(above)* vs 2X reproduction of contact *(below)* can you see the difference?



Now let us turn to making prints for photomechanical reproduction. No matter what copy is given to the photoengraver or the photolithographer, he must put it on the easel of a copy camera. He must photograph it. One expects that he will do this with a high-quality process lens. In any case, his lens is most likely many times superior to the enlarging lens to be found in the average photographic darkroom.

Since the copy is almost invariably going to be altered in size to whatever the final page layout requires, it seems most unreasonable to me that it should be altered twice. Why go once from the negative to some enlargement, perhaps an 8 x 10, and then again in the hands of the engraver or the lithographer from the 8 x 10 to some other size? Especially this is true when it is likely that the final reproduction will approximate the original negative in size. A great many of our magazine reproductions are either so-called full page, which come pretty close to an 8 x 10, or are one or two column cut size, which is the major portion of the 4 x 5 or the 2¼ x 3¼.

If we must change size, then let us change it with an apparatus that is designed to give results of the very highest quality, the process camera.

In summing up, the case for the contact print rests on its ability to hold the fine detail obtainable in the negative with modern lens-film combinations; and on its ability to reproduce faithfully the tonal relationships achieved in the negative; and the perspective relationships seen by the camera, if the lens can be chosen to include this nicety. The contact print makes no bones about stepping aside in the interest of enlargement or reduction when a size change from the original composition is necessary. It does hope however, that more of our working photographers will make the extra effort necessary to enable their pictures to be reproduced by contact, to visualize and construct their photographs in the camera so that the format of the film is used in an optimum manner, making possible reproduction without cropping.—THE END

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MEMO ON: LEASING, OR, PART 2

Leasing, long established in such fields as railway rolling stock and motor transportation, has expanded into new areas including photographic equipment. So far, it has found greatest acceptance in fields where high initial cost and/or intermittent work load make buying uneconomic and long-term renting impractical. These fields are typified by motion picture and television production and color processing.

However, it has certain advantages which could make for its acceptance in new areas, specifically in-plant photo sections. Quite often, a section is handicapped by obsolete equipment and a tight budget. Leasing could provide new equipment without a major capital outlay. This is becoming an increasing problem as automated equipment with its high initial cost begins to take over routine lab work.

A natural reaction when confronted by mankind's latest boon is skepticism, followed by the ultimate in embarrassing questions: "How much?"

In the case of leasing, this is a difficult question to answer, depending on the company, its accountant and the local collector of internal revenue. The one statement that can be made with certainty is that it is more expensive (comparing invoice price with actual cost) than cash payment or a bank loan to cover the purchase.

The figures below, based upon terms supplied by one of the leading leasing companies, will provide some idea of actual dollar costs. The terms of the lease are based upon invoice cost, which can include not only the price of the equipment but service contracts, insurance, etc.

On a one year $1000 lease, monthly payment is 9.42 per cent of invoice cost, making the total cost $1131.60, approximately 13 per cent over the cash price. A three year $1000 lease, with a monthly payment of $35 (3.5 per cent of invoice cost) would total $1260, an increment of $260 which divided by 3 gives a yearly cost of $86.66, approximately 8.7 per cent. The real cost is, of course, higher than these figures indicate since part of the lease rent is paid in advance (the last two or three payments, depending upon the length of the lease) and the system of monthly payments reduces the amount outstanding over the period of the lease. A working figure, mentioned by several sources, was 18 per cent, used as a rough indication of whether or not leasing would pay, based upon return on working capital of the firm in question.

Another factor which enters into cost evaluation is tax savings, which can be considerable in these days of 52 per cent corporate income taxes. As of this writing, however, no blanket ruling on how leases are to be handled for tax purposes exists. The one constant seems to be that a purchase option in the lease will probably make it a conditional sales contract, negating possible tax savings.

However, the real question is not how much the lease costs but whether or not the advantages justify the cost. This is the basis of a current controversy over leasing in the movie equipment field. The parties to the dispute are two of New York's leading movie supply houses, one of which is promoting leasing, the other damning it. Arguments in favor of leasing, apart from conservation of working capital and tax advantages, are that it is cheaper than renting (much movie and television equipment is rented, rather than bought) and it provides protection against obsolescence.

The opposition claims that leasing is just another form of installment buying except that the purchaser has no equity in the equipment: at the end of his lease period, he has paid for the item but owns nothing. As for rental, the higher cost is offset by the assurance that rented equipment is in perfect operating condition. Obsolescence, a factor in some fields such as automobiles and trucks, is negligible in the movie field where, according to this firm, a Mitchell movie camera, for example, retains much of its value over a long period.

At this point, the pros and cons of leasing seem to be pretty much a matter of paying your money and taking your choice. There is little doubt, however, that leasing is a growing factor in the photo field.

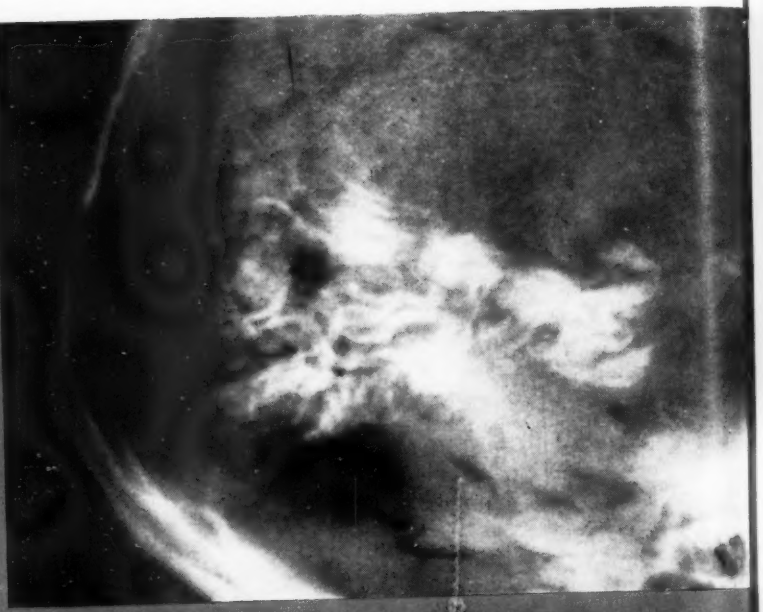
In two cases reported by Milt Frier of E. Leitz, N. Y., newspapers leased complete 35mm equipment valued at several thousand dollars. Unlike industrial leases which are handled through leasing companies, these leases were negotiated through dealers handling their own financing. The advantage of such an arrangement to the papers is that they have the use of new equipment, which, presumably will do a more effective job without a large cash outlay. In these particular cases, no down payment was required, whereas leasing company practice is to require some rent in advance. Frier is trying to promote a greater interest in local leasing and it is quite possible that larger dealers, at least, will arrange their own leases

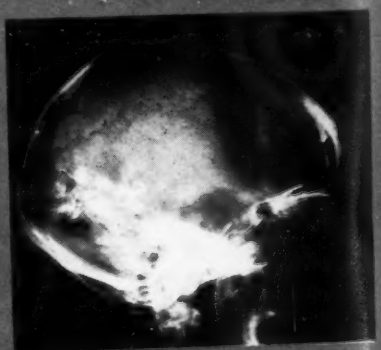
A variation in leasing arrangements is also found on some newspapers and magazines where the photographer buys his own equipment, subject to approval by the

(*continued on page* 73)

X-RAY DIAZO-COPIES

A whiteprinting machine operator is able to turn out copies of medical x-ray photographs in 2 min.





Enlarged details shown compare original roentgenogram (*x-ray at top*) with the duplicate (*left*). Entire original is above in reduced scale. Although slight differences exist between original and copy, diagnostic details are retained in copy.

A direct positive system such as diazo is ideal for the reproduction of roentgenograms for teaching purposes, but standard diazo films just weren't made for the job. This preliminary report of University of Michigan roentgenology and photographic experts indicate that new films may provide a fast, low cost, high quality answer

The duplication of roentgenograms has been a subject of perennial interest to those concerned with the preservation of case material for teaching purposes. In a large teaching center, particularly, the original films of good teaching cases may be of interest to physicians in several clinical departments. It is not unusual for films to be signed out of an x-ray department for viewing by consultants or in conference, to be trimmed and mounted for photography, and ultimately to become misplaced or to take an honored place in the collection of interesting material of a colleague or a departing trainee. Valuable films placed in student teaching collections are subjected to wear and tear and eventually need replacement. In institutions with large student loads, some duplication of student teaching material would be advantageous for teaching parallel groups.

The usual photographic processes can produce satisfactory duplicates of roentgenograms only by use of an intermediate negative and hence two stages of wet processing. Solarization procedures can be employed, but standardization of the procedure is difficult and wet processing is still essential. Direct contact printing gives reversal of the image and therefore is not satisfactory for teaching purposes. Log-Etronic procedures can be utilized, but the equipment is relatively expensive and frequently the film texture is sufficiently changed to make it somewhat less desirable for presentation to groups inexperienced in roentgenology.

Because of the extensive use of the diazo methods in other fields of duplication and because of the easy availability of the equipment, application to the problems of duplication of roentgenograms was attempted by one of us (F.J.H.) in the early 1940's. The sensitized diazo materials available at that time were not adequate to produce the needed diagnostic detail, however. When it came to our attention that progress had been made in the production of continuous tone sensitized diazo transparent material, further trial in the reproduction of roentgenograms was thought desirable.

The material presented for trial was a doubly sensitized transparent base designed for continuous tone direct positive reproduction. The equipment for processing was the standard diazo machine used for other university documentary reproduction. The process is carried out in a lighted room. The transparent sensitized material is placed in contact with the roentgenogram and the combination then placed in the roller system which exposes it to ultra-violet light from a mercury vapor lamp. Varying exposures can be achieved by changing the speed of the roller system, which is calibrated in speed of transport of film in feet per minute.

The exposed diazo sheet is then passed through the development cycle in ammonia vapor. The use of doubly sensitized material necessitates two passes through the development cycle, one for each surface of the sheet. The entire process from the first handling of the roentgenogram to the production of the dry direct positive duplicate transparency takes under two minutes.

The resultant duplicate transparency demonstrates the continuous tone of the original roentgenogram with practically all of its initial detail. Detail is sufficient to maintain diagnostic quality. The major detectable differences in comparison to the original are the thinner and more flexible film base and the varying shades of blue in which the details are depicted.

The transparent duplicate can be used in the same fashion as the original. Also, cropping and marking can be done on the duplicate and the duplicating process can be carried out repeatedly without harm to the original film.

In addition to the obvious advantages of this material for teaching purposes, other applications suggest themselves. Duplications of important films could be used for answering requests from other hospitals to which the patient might go. Demonstration of pathology to referring physicians could be achieved easily by sending a duplicate of the key film with the written report without disturbing the complete film file of the patient in the radiologist's office. Another important application would be the copying of significant outside films; if an operation was performed on the basis of definitive preoperative studies made elsewhere, the duplicate would provide a permanent record of the patient's preoperative status.

Cost of the duplication material is not yet established, but is estimated to be comparable to that of x-ray film. The equipment for exposing and processing the duplicate is already in general use in many teaching institutions and no special adaptation is required.

This article, by Walter M. Whitehouse, M.D., Fred Anderegg, M.S. and Fred J. Hodges, from the Department of Radiology, The University of Michigan Medical Center and the Photographic Services, The University of Michigan, Ann Arbor is reprinted with the permission of the editors of the University of Michigan Medical Bulletin, *Vol. 26, No. 3, March 1960.*

The double sensitized diazo film for the tests was supplied by the Ozalid Division of the General Aniline and Film Corp.

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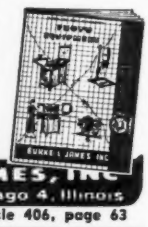

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ONE-MAN AUTOMATION

(*continued from page 42*)

used in the *Encyclopaedia Britannica.* For some photos, the audience is estimated at over 7,500,000 people. A reason for this is that only cameramen cleared for security can be admitted.

Possibly the most unusual aspect of the photo section at Hanford is the high degree of automation. Long a fixture in photo finishing and movie processing, automation is a comparative newcomer to the industrial photo lab. The reasons are two: first, it is expensive, the Hanford installation costing over $10,000; and second, the work load in most labs is intermittent and not usually heavy enough to warrant automation.

At Hanford, the average monthly output is 20,000 prints, of which 9,000 are made on automatic equipment. These 9,000 represent print orders of from 40 to 600 from a single negative (in one case, the order was 10,000 prints from one negative). These pictures are used as part of reports and internal publications and are made photographically to preserve detail which would be lost had offset been used. Orders under 40 prints from one negative are made using regular enlargers.

In preparing a report photo for large scale printing, the first step is to copy the print on 8 x 10 Kodalith and Gravure Copy film. The Kodalith negative preserves line detail such as graphs and notes, while the Gravure Copy negative is used for continuous tone. Typical subjects for these copies would include metallographic and micrographic prints which are included in engineering reports. The 8 x 10 Linhof with 12-in. Dagor lens is used.

The Kodalith negative is stripped and combined with the Gravure Copy negative. The prints are made on an APAC 11 CP-Spec printer. The "spec" indicates it was modified to meet specific needs of Hanford. Two ten millisecond relays were added; one to turn off the printing light before the platen rose, the other to delay turning the printing light on when the platen went down. This was done to reduce the possibility of bleed, stray light which would affect adjacent prints. An electric numbering device to indicate the number of prints already made was added. This is necessary when printing breaks off in the middle of a run. The printer can thus tell how many prints were made compared to his order. The 60-watt printing bulbs supplied with the APAC machine were replaced by 40-watt bulbs in an effort to reduce the possibility of bleed near edge of the print.

Finally, there was the basic modification to permit the printer to accept paper in 11½-in. rolls rather than 11-in. rolls. Instead of making prints crosswise, as is normal, the prints are made lengthwise, making it easier to get the 8½ x 11-in. prints which are bound into reports.

Contrast control is achieved by using different paper grades. The copy negatives, which run on the thin side, are sorted according to the grade of paper needed.

A nick is made in the roll after each print. This activates the Pako Van-Pak 10-in. cutter. Processing the rolls of paper is a Pako Prosser. Here, Dektol 2:1 is used instead of the suggested Dekomat developer. It is felt that the recommended print developer does not give the desired quality. A Pako 26W dryer is used. This is a hot water dryer, chosen instead of the usual in-line dryer because it would accept two rolls, or one roll and one line of sheets, at one time. After being cut, the prints are put through a Kodak print straightened. Kodak Velox paper is used for all prints made this way.

On smaller orders which are made on 4 x 5 Beseler enlargers, Kodabromide is used, also developed in Dektol. This method is used for all new pictures.

The decision to automate was made by Brewer in consultation with the two group leaders, Robert Clemensen and J. L. Hascall. It was based upon the growing work load and the cost of additional manpower as against the cost of automation. One man, hired to replace a girl printer who left, runs the automatic equipment and also doubles as a cameraman.

The results of this decision can be seen in the price list. The charge for 8½ x 11 prints was reduced from 60 to 50¢, with the quantity price (over 35 prints from one negative) dropping from 45 to 35¢ per print. The same size print as an enlargement costs 75¢ with a quantity price (over 50 prints) of 55¢. It is estimated that automation has saved customers of Hanford Photographic Operation over $2,500 in a little over six months. As far as Hanford is concerned, this settles the argument.

CATERPILLAR TRACTOR
(*continued from page* 35)

factory by air greatly minimized the need for experts on the premises.

Though all the printers are located in one darkroom, he has provided for curtains on tracks which permit screening off the unit which needs service so that darkroom operations can go on.

Andrews is sure his installation will prove a success. The fact that one of his printers, though still a novice on the machine, turned out 1,300 prints in eight hours without one reject, bears him out.

The department yielded many other signs of progressive thinking. For example, an installation designed by EDL of Gary, Ind. for processing all the Caterpillar microfilm is under way. Designed to reduce cost, save time and reduce the problems of espionage, it will be one of the first such installations anywhere, they say.

Light-tight Modernfold doors are used to divide darkroom space to eliminate need for separate rooms where only occasional need for separation existed.

Red filter windows are used when making contact line negatives, which provides a handy working area.

A Graflock back is arranged to mount in the film holder area of the process camera so that film packs, or holders, or Grafmatics can be used to shoot large numbers of 4 x 5 halftones.

The Photostat Junior Continuous Platemaster is used with Eastman Orthothin paper in rolls to make large numbers of negatives for Multilith Masters most rapidly.

The image reversing mirror was removed, and an ordinary easel used. The paper negatives are printed through the paper onto the master without any appreciable loss of detail.

Self-service copies

A do-it-yourself photocopy area has standard copying machines such as the Verifax where various departments can make their own copies of letters and documents.

Just as impressive to this observer as the emphasis on efficiency at Caterpillar is the morale and competence of the people. Each of them seemed too proud of his craft to settle for less than fine quality. The result of course is a high level of quality even with the extremely high production rate. Without this spirit, the practicality of this, or any system like it, is dubious.—THE END

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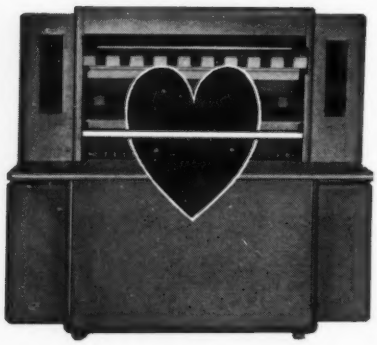

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PMI IN-PLANT REPRODUCTION

Vernon Tate

MICROREPRODUCTION

There's plenty to chew on in the literature of microreproduction

The search for timely and accurate information about microreproduction would be a completely absorbing full time job if anyone had the opportunity to undertake it. In fact, as the perimeters of the field enlarge and become intermingled or absorbed into old as well as new concepts and undertakings the information thread is spun so fine as to appear tenuous. This means that more and more articles especially about applications appear in quite highly specialized journals and similar publications often of limited circulation. Complete books and even monographs in this field have never been numerous but there are welcome signs that this deficiency is being corrected. As several new publications have appeared earlier this year, some review of these new additions to the literature seems definitely in order.

Librarians have traditionally been generous contributors to the literature especially if library problems are involved. Microreproduction is no exception and although the articles are addressed primarily to library problems, there is always ample information included that is most useful in other areas. An example is the section by Alan B. Veaner, Specialist for Documentary Reproduction of Harvard University Libraries entitled "The Literature of Documentary Reproduction" in *Occasional Papers of the University of Illinois Library School* (No. 58, March 1960). In 13 pages the author lists and briefly evaluates some 60 sources of information that everyone in the field should know. (Note: the *Occasional Papers* are distributed free of charge within the limits of the edition by the University of Illinois Library School, Urbana, Ill.)

Another important library enterprise is going forward at Rutgers University. Dr. Ralph R. Shaw, Dean of the Library School and himself no stranger to microreproduction with his work in photo charging and the rapid selector, has assumed general editorial supervision for a series of volumes on *The State of the Library Art* which are now appearing. Of particular significance is Volume V which contains three separately bound studies: Part 1 by Reginald Hawkins, *Production of Micro-Forms* (208 pp.); Part 2 by Jean Stewart, Doralyn Hickey and others, *Reading Devices for Micro-Images* (205 pp.); and Part 3 by William Hawken, *Production of Full-Size Copies,* (not yet published). The set is being produced by Rutgers University Press, New Brunswick, N.J., and single volumes can be obtained. In the two books now in print the device of collecting references to the literature, 439 for the first named and 405 for the second, has been used. These are arranged and abstracted with editorial comment when necessary to form a narrative. Unfortunately no illustrations are included. As indicated both deal with library problems, but there is enough general information to make them good reading for non-librarians as well.

Considerable activity by librarians and documentalists in Europe has resulted in publication. Mention should be made of the 22-page monograph by L. L. Ardern, *John Benjamin Dancer, Instrument Maker, Optician and the Originator of Microphotography,* published by the Library Association in London. Interestingly enough, some of Dancer's microcopies made a hundred years ago rival contemporary work in high reduction. A detailed study of his methods and their adaptation to take advantage of currently available facilities would be rewarding for the experimenter. Dancer by the way was awarded a Pioneer Medal by the National Microfilm Association in 1959; an account of its presentation to his grand-daughter with further information about this interesting man will be found in the June, 1960 number of the *National Micro News.* George H. Davison's *Microtext in the form of*

Opaque Cards and Transparent Microfiches: A Review of Progress 1959, is worth looking over. The author is the Secretary of the Research and Development Department of the United Steel Companies, Ltd. Another British import is *Microtexts as Media for Publication*, 87 pp. which is the report of a symposium held in November 1959 at which four international experts, three Americans and a Dutchman, discussed microfilm, microcards and microfiche as vehicles for publication.

Insofar as equipment is concerned, the National Microfilm Association last year published the *Guide to Microreproduction Equipment* edited by Hubbard W. Ballou which rapidly became a best seller in the field and ran through three printings. This year a *First Supplement* (120 pp.) to the *Guide*, also edited by Mr. Ballou, appeared in April with corrections, additions and new material to bring the treatment up to date. The *Guide* and its *Supplement* constitute the best existing source of information about microreproduction equipment made or sold in the United States and are cornerstones in any working library.

A new book by Arthur D. Even, *Data Processing System Design* (VanNostrand, 1960, 282 pp.) has been written from an entirely new viewpoint. The author is an experienced systems consultant who is at home in the microreproduction field. He approaches the problem of controlling engineering data from the viewpoint of management. Not only are the technical operations involved in utilizing microreproduction techniques fully covered but also the essential and often overlooked procedures of informing and in some cases "selling" management on a program are treated. Of great interest is the fact that all of the equipment recommended is well tested and available from stock; no new concepts, new equipment or development work is visualized. Engineering documentation is a live field, and when a book of this type can be written for units in production and readily available, then the industry is about ready to shift into high gear. In fairness it should be said that the book is not comprehensive in that all possible avenues of procedure are not covered. This book is the forerunner of others which will doubtless appear for related fields. It is understood that publishers are now considering and even readying additional manuscripts.

Of equal significance and much more particularized is a current report by Thomas H. Korte, Thomas C. Myers and John W. Beery of the Directorate of Engineering Standards, Wright Air Development Center entitled *Microfilm Aperture Card System*. (154 pp., available to "qualified requesters" through ASTIA.) The report which is well illustrated confirmed the theory that the solution to the overall problem of handling engineering drawings, at least so far as the Air Force is concerned, was the combination of microfilm and automatic data processing into a single integrated automated system.

It is interesting to note that literature issued by manufacturers of equipment and supplies continues to increase both in quantity and in quality. These fugitive pieces are hard to locate (the best source is usually a convention or display) and a well arranged file is a real asset.

Finally, by the time this column is published the Proceedings of the 9th National Microfilm Association Convention held in New York in April 1960 will be available and will contain some 40 papers dealing with all aspects of microreproduction.

Information still is not always easy to procure but the sources are multiplying rapidly.—THE END

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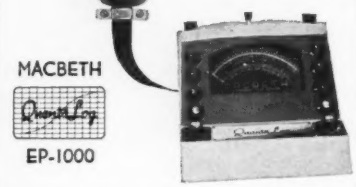

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GRAPHIC ARTS

Color theory: scientific world vibrates with variegated notions

The highly publicized two-color experiments of Dr. Edwin Land, have certainly stirred the imagination of the scientific world as well as that of the public at large. While there is nothing radically new about Dr. Land's work, there is no question but that the results obtained with abridged color systems prompt us to reevaluate our thinking about the human visual mechanism. Very possibly the impetus provided by Dr. Land's demonstrations may lead to experimental data that will invalidate our currently accepted theory of color vision—or confirm it.

The public at large is not only impressed but, unfortunately, very much confused. In the graphic arts field color printers have visions of reproducing in two colors subjects that now require three, four or more separate colors. In other fields too, many are under the impression that a new theory of color vision will obsolete present color reproduction systems.

The confusion stems from the failure to differentiate between trichromatic color mixture and the trireceptor theory of human color vision. In the minds of many the two are one and the same. Actually they are distinctly separate entities. Although both may be considered theories, only one remains a theory, the other is an indisputable fact.

Tri-color theory

The theory of tri-color synthesis merely states that any given color can be matched by mixing three selected spectral colors in definite proportions. This is not true in the fullest sense, nor does it imply that we can obtain a precise match of the physical energies involved. Instead, it means that we can simulate a specific color sensation by some combination of, for example, red, green and blue light. In certain instances we can do this with only two colors (usually complementaries), or with only one color and white light. But if we confine ourselves to the least number of pre-selected colors with which we can simulate the full gamut of color sensations, we find we cannot use less than three.

That this is a fact and not merely a theory is proven by any number of practical applications with which we are all familiar. Color photography, color printing, color TV, and color measuring instruments such as colorimeters, regardless of their shortcomings, are all examples of the validity of the tri-chromatic theory.

The basic work with color theory and tri-chromatic mixture (which preceded the foregoing practical applications), lead to the concept that human color vision is likewise tridimensional. According to this theory the retina of the eye contains a mixture of three distinct receptor groups —each responding to wavelengths of light roughly covering one third of the visible spectrum, and loosely defined as red, green and blue. In many cases the laws of color mixture correlate very nicely with the observed reaction of the visual mechanism. Many aspects of defective color vision can be explained on the basis of the tri-receptor theory. There is, in short, a wealth of experimental data that can be interpreted in support of the tri-receptor theory. But, in common with a lot of other theories, it is unable to fully explain all the facts.

Whereas the tri-color theory seeks substantiation on the basis of the stimulus, the other most prominent theory is based on an interpretation of real visual experiences. The opposing-color theory acknowledges red, green and blue as primary sensations but adds a fourth—yellow. According to this theory yellow mixes with red and green, but not with blue. Blue mixes with red and green, but red and green don't mix. Thus, there are four distinct color sensations, plus white and black, whose combinations provide all other sensations. This concept suggests that the color receptors in the retina

have dual, but opposing, reactions. Three pairs of sensitivities are alleged to exist—red-green, blue-yellow and white-black. Wavelengths in the green region striking the red-green receptors would induce a green sensation and suppress a red sensation. Experimental data likewise can be interpreted to support this concept. This theory too fails to explain all of the known facts of color vision. Other theories that may be given credence are either variations or blendings of the two foregoing ideas.

The human eye

That the retina of the human eye contains light sensitive elements is, of course, obvious. We have adequate evidence that two kinds of receptors exist—rods and cones. The rods are considered to be utilized mainly for seeing in dim light, while the cones are responsible for distinguishing color and detail at higher illumination levels. Research has revealed that the rods contain a light sensitive substance named rhodopsin which, when subjected to light, bleaches and changes the electric potential of the eye's nervous system. This one aspect of the visual mechanism is well known and has been, in fact, recreated in the laboratory. It is theorized that the cones function in a similar manner but with specific sensitivities to certain bands of radiant energy. Despite extensive research on the subject, there is no supporting evidence to prove just how the cones operate, or whether there is actually any difference in cone sensitivity.

So, the matter of human color vision remains a matter of conjecture. Regardless of the outcome of the conflict in color theories (visual), the reproduction of color by tri-color synthesis will continue to be a dominant and reliable system.

A number of other points should be considered in evaluating abridged color systems. Two-color methods date back to about 1895 and thus have had ample opportunity for development. Of the countless number of two-color systems devised since the method was first proposed, none have survived in competition with the superior results of the tri-color methods. Most of the current effort is based on the projection of images in which case the effects are developed by the additive mixture of lights. We should be aware that the bulk of our visual experiences are by reflected light, governed by the multiplicative, or subtractive laws of color mixture. Many of the startling effects induced by the projected light simply don't happen under reflection viewing.—THE END

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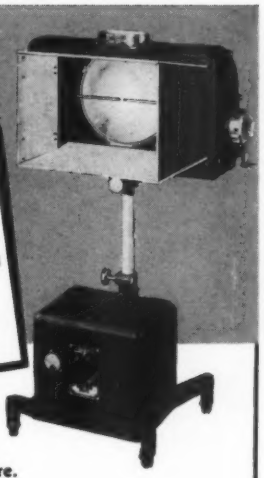

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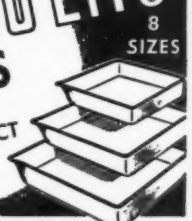

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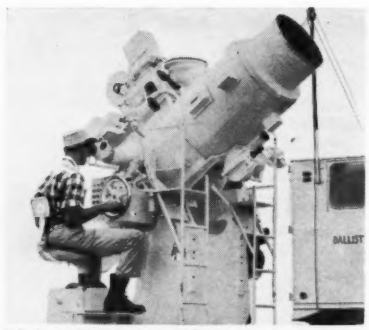
EARLY MISSILE TRACKING

The first useful photographs of liquid-fueled rockets may trace back to the twenties when a news photographer recorded the experiments of Staten Island's now-famous Dr. Goddard. But the value of missile photography was not established until Eyemos with telescopic lenses showed the instability of captured V-2's. Here Bennett Sherman follows the early path of missile tracking cameras onward and upward



Tetra Tracking Camera built for White Sands Missile Range has main mirror with 18 in. diameter.

First Tracking Telescope at White Sands. A pair of refracting telescopes with Eyemo cameras on gun mount.

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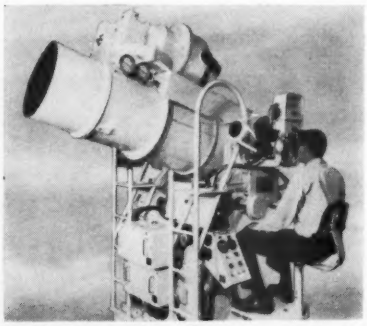
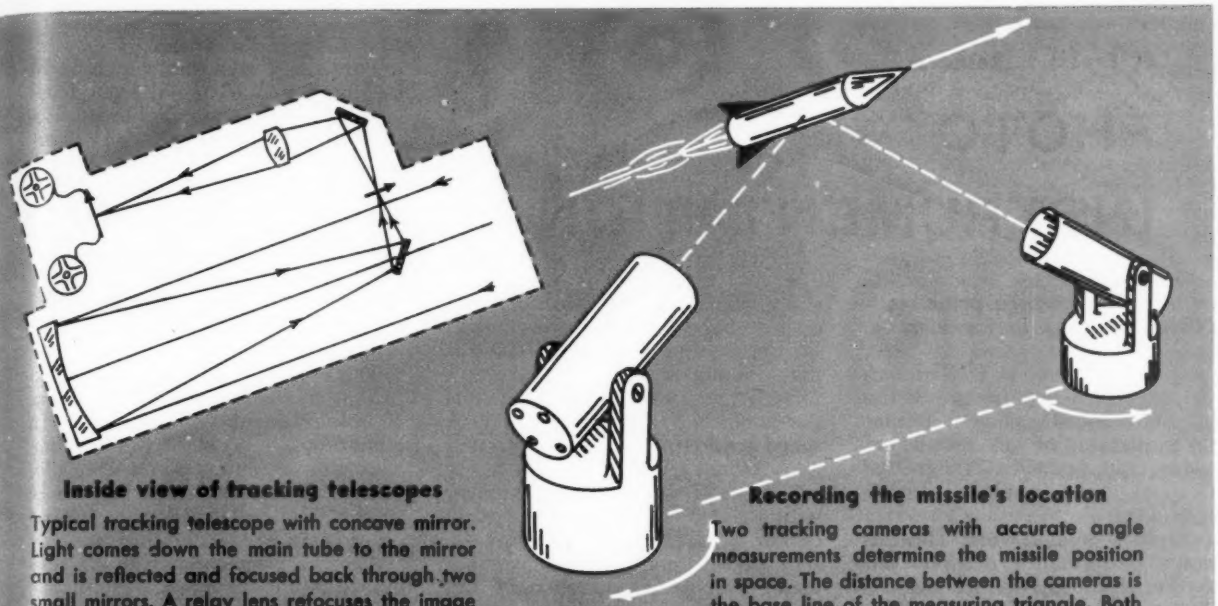


IGOR Tracking Camera built by the J. W. Fecker Corp. features an automatic focus system.

Even though the Germans launched more than a thousand V-2 rockets during World War II, no one had ever taken motion pictures with large telescopic lenses to track and record the flight and range of the V-2s. The Germans had used a large theodolite (surveying instrument) equipped for photography, but at a distance of 20 miles, the V-2 was hardly more than a dot on the film.

Long-range photography of missiles came into its own on Dec. 5, 1946, at White Sands Missile Range when the U. S. Army Ordnance took the first telescopic motion pictures of a V-2. When the pictures were developed and examined a definite yawing of the rocket after burnout of the engine was noted. The missile men at the range were greatly impressed. As the Ordnance Department has stated in articles released by its public information office, the technique of precision long-range photography of the missile in the United States began at that time.

However, the first useful pictures of a liquid-fueled rocket may have been taken by the enterprising news photographer who witnessed the experiments of Staten Island's now



Inside view of tracking telescopes

Typical tracking telescope with concave mirror. Light comes down the main tube to the mirror and is reflected and focused back through two small mirrors. A relay lens refocuses the image on the film, magnified. The effective focal length of the telescope is the focal length of the main mirror times magnification of lenses.

Recording the missile's location

Two tracking cameras with accurate angle measurements determine the missile position in space. The distance between the cameras is the base line of the measuring triangle. Both cameras turn in azimuth *(arrows at ground)* and in elevation. Angular measurements, plus data from image permit triangulation.

famous Dr. Goddard in the 1920's. The word "useful" is taken to mean photographs which, at least, contribute to a better understanding of what is happening during the launch and flight of a rocket.

The earliest efforts to create equipment specifically for photographic observation and data-taking was the modified M-45 Army anti-aircraft gun mount carrying two telescopes with Eyemo motion picture cameras and Barlow negative lenses to increase the effective focal lengths. Working first under the direction of Dr. J. B. Edson, and later the famous Clyde Tombough, these telescopic cameras gave the first pictures of a V-2 showing the instability in the flight and missile attitude after engine burnout. The Ordnance Department of the U. S. Army, at Aberdeen Proving Ground, Md., built most of the earliest tracking telescopes used at White Sands. More recently, the White Sands personnel have done most of the engineering and experimentation in the development of the newer and larger tracking telescopic cameras. American optical manufacturers have contributed greatly in this development. Most notable among these are two well-known optical companies particularly prominent in the construction of large astronomical telescopes: J. W. Fecker Co., and the Perkin-Elmer Corp.

Just what are the missilemen looking for in the collection of data using these big photographic "guns"? In a symposium of the Society of Motion Picture and Television Engineers two years ago, A. H. Schendel of the White Sands Missile Range Instrumentation Division described some of the desired information and required performance of the tracking telescopic cameras. They are summarized as follows:

(1) To give a pictorial record of the external events of the rocket flight with a time reference. These include attitude, roll, yaw and pitch.

(2) To give position data, at least in angular coordinates.

(3) To work in conjunction with another like instrument to yield space position data.

(4) To have a long-focal length objective of sufficient image quality to give the desired resolution and image clarity.

(5) To have a motion picture camera mechanism permitting a running record of events.

(6) To have an accurate time reference, preferably real time. That is, time references tied to the rocket launch and to other instrumentation covering the same flight.

(7) In the case of moving telescopic cameras which will track the missile during flight, to have smooth and accurate aiming facilities, including guide telescopes for the observers and, if necessary, power drives controlled by the observers. Often in the acquisition of a missile in flight which can not be readily seen and picked up by eye, the telescopic camera should be guided in by other equipment—notably radar. This means a photographic coverage sufficient to bring the missile into view and the film area when guided in by the less accurate or lower resolution radar.

Even though the earlier telescopic cameras grew in size to rival smaller astronomical telescopes, still, the resolving power was not good enough to cover the entire flight of a rocket with a range such as the Viking's from launch to impact. The White Sands Missile Instrumentation Group soon evolved into two large divisions: the South

(*continued on page* 71)

by Ernest E. Reshovsky

PHOTO INSTRUMENTATION

New ballistics camera promises greater accuracy in tracking

In a previous column (*PMI, May 1960*), we discussed the use of the Wild BC-4 ballistic camera for in-flight positioning of missiles. These cameras, equipped with 300mm f/2.8 lenses, can be used to place the position of a missile to within 5 ft. at a camera distance of 100 mi. This impressive performance may be improved upon shortly when a new ballistic camera makes its apperance on the tracking range.

This camera is being built by Nortronics, a division of North American Aviation, to the specifications of the Photo Instrumentation Branch at Cape Canaveral. They needed an instrument with higher accuracy, and greater light-gathering power than existing equipment affords. The format, 180mm square on a 190mm x 215mm spectroscopic plate, remains the same, but focal length and lens speed are doubled. The new lens will be a 600mm f/2.

Glen C. Wooters, a senior engineer with a long background in optical design, is in charge of the lens design at Nortronics. He is working under the overall direction of Dr. Pestrocov, chief of optical systems at Nortronics. Project engineer on the ballistic camera is Leo Deterding. We discussed some of the problems involved in meeting the general specification with both men.

The lens computation is derived from a basic lens design by David S. Gray of Polaroid who designed a 6-in. f/2 lens to cover a 4 x 5-in. format in 1947-1948. In the process of increasing the lens from the design focal length (6-in.) to the desired focal length (24-in.), many problems arise, some of which are due to sheer size.

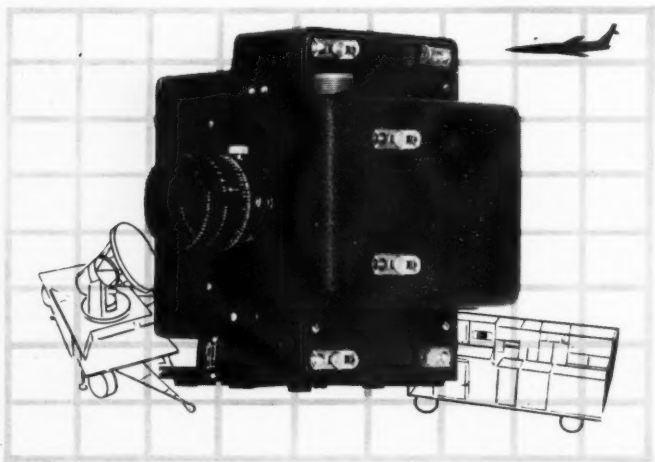
The lens has nine elements, with 18 glass-to-air surfaces, and weighs about 200 lbs. The camera weight will be about 500 lbs.

Under the specifications, the lens must have less than five microns of tangential distortion and less than 25 microns of radial distortion. (A micron is 1/1000 of a millimeter or 1/25,000 of an inch.) Tangential distortion is a lens mounting problem. If one element is misaligned in mounting by .005 in., it would introduce the maximum permissible distortion (5 microns) into the whole system. The radial distortion, on the other hand, is a design problem.

Another specification calls for general stability across a temperature range of 20-120 degrees F. This is being accomplished by using an adjustable focal plane, calibrated for various temperatures. The adjustment is made by interchangeable steel blocks of varying thickness

(*continued on page 60*)

Radar on Target—PROVE IT!



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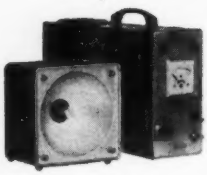

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HYZER ON HIGH SPEED

Bill Hyzer analyzes two more aspects of image blur: image elongation and event duration

Last month the author discussed the effect of image blur on image quality, followed up by a useful chart for estimating picture frequency as a function of subject velocity, field width and camera shutter-speed characteristics. Although a chart based on these factors is directly applicable to a wide range of photo instrumentation problems, the broad subject of picture frequency estimation is more involved than this simplified chart might make it appear. Actually, image blur as a direct function of frame size is only one of several factors that should be considered when high-speed photography is applied to a motion analysis problem. In practice, several criteria for determining picture frequency must be applied to each problem, and the best estimate derived by compromise within the limits imposed by these various conditions. Exemplary are the criteria based upon: 1) Permissible image elongation and 2) event duration, which will be discussed in this order.

When the moving object to be analyzed is small in comparison to the field width covered, the degree of blur permitted by last month's chart may consume a goodly portion of the recorded image in its direction of motion. A companion chart, Figure 1, has been prepared to yield picture frequency correction factors that may be applied to meet these special conditions. Object sizes measured in the direction of motion, and expressed in per cent of field width (W), appear across the bottom of the chart as abscissa. The family of diagonal lines on the chart correspond to various image elongations (e) caused by blur and are expressed in per cent of object size. Recommended values of e depend upon the fineness of detail to be resolved in the moving part, the size of the image in relation to the static resolution of the camera-film combination and upon the ultimate measurement or recognition accuracies required. Ordinarily the general shape characteristics of an object may be recognized from its photograph if e does not exceed 10 to 20 per cent. If critical measurements are to be made from the image, e should be an order of magnitude less or about 1 to 2 per cent. For extremely small images that approach in size the static resolution limit imposed by the lens-film combination, smaller values of e will be required. For purposes of estimating picture frequency however, the above values are representative. The ordinate or vertical scale to the left of the chart provides the multiplication factors required to correct the picture frequency obtained on the basis of last month's chart. Application of the above principles can best be described by citing a typical problem.

Example: We propose to photograph the flying metal fragments from an exploding fly-wheel rotating at high speed. Minimum dimension (P) of the fragments to be analyzed is estimated to be 0.6 in. Velocity is about 5000 in./sec. What picture frequency is required to evaluate the approximate size and shape of these fragments within a field width (W) of 20 in.? Preliminary calculations are based on a 16mm camera having a shutter constant of 0.2. From last month's chart, estimated picture frequency is 10,000 frames per second, based on an acceptable blur criterion of ½ per cent of the frame width. To properly determine the shape and approximate size of these particles however, the blur due to image motion must be maintained within a small fraction of the particle image dimension measured in the direction of motion. e = 4 per cent is chosen to be adequate in this case.

Applying this information to the

(*continued on page* 74)

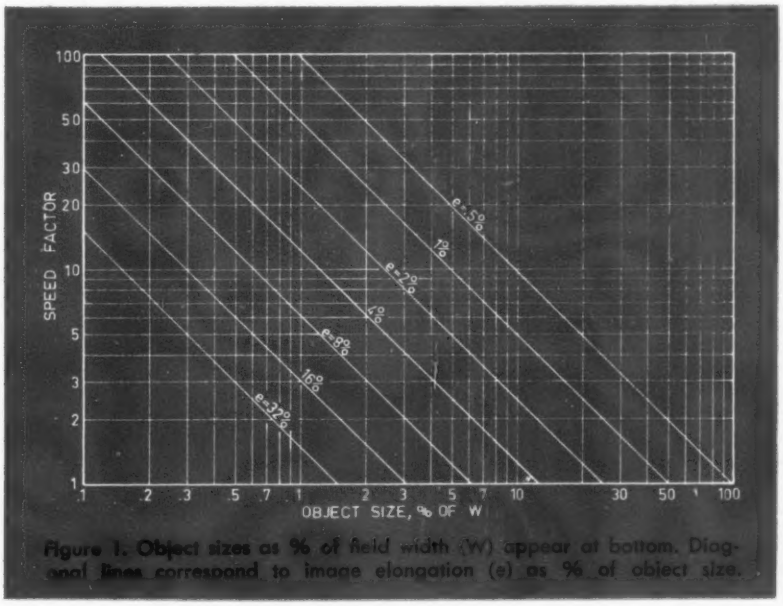


Figure 1. Object sizes as % of field width (W) appear at bottom. Diagonal lines correspond to image elongation (e) as % of object size.

PHOTO INSTRUMENTATION

(*continued from page* 58)

which act as shims.

The camera will be equipped with a louvre-type shutter which can be pulsed at a rate of 20 pulses per sec. with a shutter speed of 1/120 sec. The shutter has to operate with a constant efficiency of 80 per cent. High, even with small shutters, this figure will hold for a shutter which operates in a lens nearly 18 in. in diameter.

The whole instrument is designed to be supported by three steel posts resting on a lapped surface accurate to within five seconds of arc. During rotation and positioning of the in-instrument, rollers are raised within the mount. They are retracted before the camera is operative.

In addition to greater accuracy for in-flight positioning, it is quite possible that the Nortronics Ballistics Camera, with its high light-gathering power, will be useful in obtaining satellite orbit information. Six units are being built with an initial delivery date of January 1961. The project, which started in March, 1960, will have been completed in only ten months. (This figure includes lens design and construction.) In terms of normal lead time it's an amazing feat.

Dr. Fink of Sylvania has designed this sequencer for use with their FF-33 Floodflash bulb. Used by many in high-speed work, the bulb will light 37 ft. of film at 2000 frames per second. Flash duration is 1.75 sec. This sequencer will meet the need for a method to fire more than one bulb to allow for longer runs. It will handle five bulbs (total time 8.75 sec.). The unit is completely self-contained and can be built by anyone with a soldering iron.—THE END

COMING UP

(*continued from page* 10)

New York Chapter SPIE Meetings every third Thursday. Contact Don Bass, P.O. Box 177, Bethpage, L. I., N. Y. Liggett 4-8196. **New York City Chapter SMPTE** Meetings first or second Wednesday of each month. Contact Ed Warnecke, Eastman Kodak Co., 342 Madison Ave., New York, N.Y. MU 7-7080.

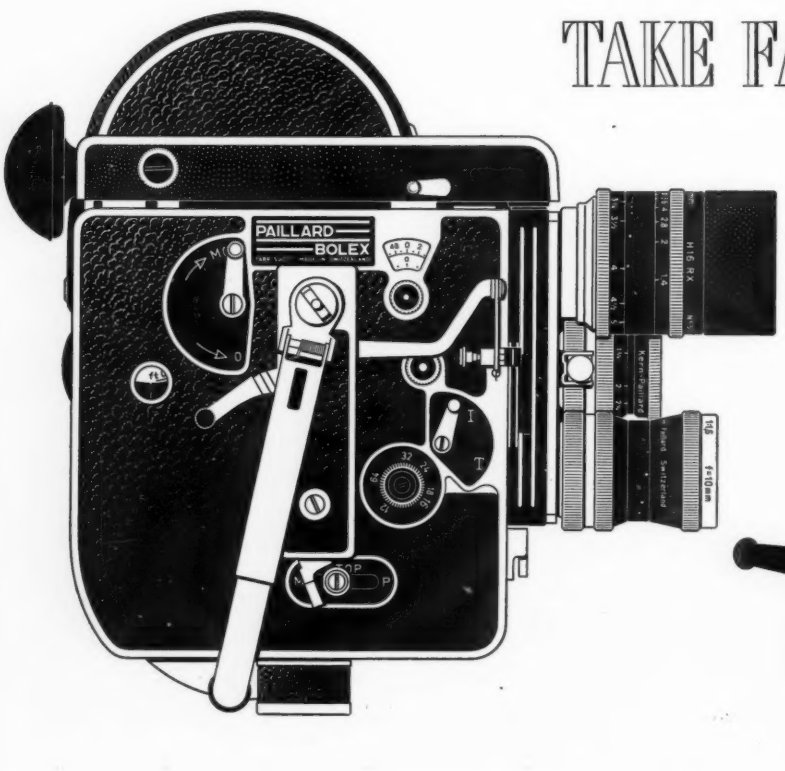
Binghamton Chapter SPSE Meetings every third Tuesday. Contact H. G. Morse, Ansco, Binghamton, N. Y. RA 2-4221 Ext. 573.

Rocky Mountain Industrial Photographers Meetings every fourth Monday. Contact P. H. Broadie, 2170 S. Lincoln, Denver 10, Colo. Telephone PEarl 3-2200.

Southern California Chapter SPSE Meetings the last Monday of each month. Contact Ben Augustine, 235 Annandale Rd., Pasadena 2, Calif. Telephone MU 1-0076.

Southern California Chapter Industrial Photographers. Meetings every third Tuesday. Contact Janet Marshall, Executive Secretary, 5463 Virginia Ave., Los Angeles 29, Calif. HO 5-6614.

TAKE FADES...LAPS...



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FREE LITERATURE

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AUDIO-VISUAL

SOUND FILMSTRIP **201**
DuKane Corp. Reprint from *Salesweek*, "Projector Puts Sales in Green Pastures," tells story of DuKane's Mite-E-Lite portable sound filmstrip projector as utilized by International Harvester.

FILMSTRIPS/SLIDEFILMS
Graphics Institute. 20-page illustrated booklet, *What You Need to Know About Filmstrip/Slide Shows*, gives a picture of the benfits, problems and procedures in setting up a filmstrip/slide show program. Request on company letterhead.

ARC SLIDE PROJECTOR **202**
The Strong Electric Corp. Illustrated brochure describes the Strong Arc Slide Projector for large screen slide projection.

TELESHOW **204**
Staples-Hoppmann, Inc. Illustrated specification sheet describes the Teleshow, a rear projector available with or without slide-sound synchronization.

U.S. GOVERNMENT FILMS **203**
United World Films, Inc. 24-page catalog lists over 400 U.S. Government films for industrial training and vocational school courses. Subjects range from studies of rockets and outer space exploration to simple how-to films.

EQUIPMENT

REFLECTO-LITE **222**
Scheibe Engineering, Inc. Illustrated specification sheet gives data on Reflecto-Lite flood reflectors, spotlights for 3200K and Nos. 1 and 2 photofloods. Includes prices.

TEMPERATURE CONTROL **223**
Temprite Products Corp. Specification sheet gives details of the Temprite photo processing cooler for finger-tip water temperature control.

COLOR PROCESSING SYSTEMS **224**
Arkay Corp. 4-page illustrated folder describes the Arkay Deluxe Color Print Processing System, Model 1620-14CP, for prints 16 x 20 and smaller.

LOWELL LIGHTS **225**
Lowell Light Photo Engineering. 4-page illustrated reprint from *American Cinematographer* discusses Lowell Light unit that "mounts anywhere."

GRAPHIC ARTS

WHITEPRINTER **228**
C. F. Pease Co. 4-page illustrated folder describes the Scout full-width whiteprinter. Includes complete specifications.

STAT-LITE **229**
ColorTran. Specification sheet describes the ColorTran Stat-Lite for photostat operations. Includes prices.

CLYDESDALE CAMERAS **230**
Process Cameras & Equip., Inc. 12-page illustrated catalog gives complet specifications on Clydesdale darkroom cameras and accessories. Includes prices.

OFFSET PACKAGE PLANS **231**
American Type Founders. 4-page illustrated folder describes two small offset package plans available from ATF to set up an offset shop.

PROCESS CAMERAS **232**
Kenro Graphics, Inc. 4-page illustrated folder on two process cameras, the Vertical 18 and the Vertical 24 and their accessory equipment.

(*continued on page* 62)

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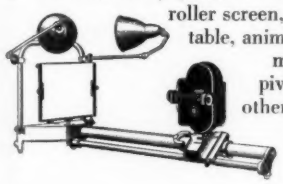

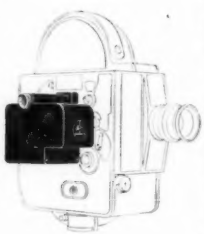

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PHOTOCOPY CATALOG 218
Cormac Photocopy Corp. Catalog gives information on the complete line of photocopy equipment and accessories manufactured by Cormac. Included is a listing of Cormac's dealers and service stations.

KALFAX DEVELOPER 215
Kalvar Corp. 4-page illustrated folder gives specifications on the Kalfax Developer—a high-speed continuous roller type unit for developing Kalfax films.

DESK-TOP COPIERS 211
Cormac Photocopy Corp. 4-page illustrated pamphlet describes the Cormac line of desk-top photocopiers. Includes list of Cormac service stations.

SERVICES

COLOR STOCK LIBRARY 233
Lem Baily Productions. 4-page folder lists catagories on which this California firm has film coverage. Price list is included.

MOOD MUSIC LIBRARY 234
Audio-Master Corp. Revised edition of the *BG-Library of Mood and Bridge Music* lists tunes in 21 catagories. Includes a brief description of each selection.

EKTACHROME 237
Byron Motion Pictures, Inc. Memo on Eastman Ektachrome from this Washington, D.C. lab lists services, technical information and comments on the film. Includes prices.

COLOR PRICES 238
Cascolor Laboratories. Price list for Ektachrome, Ektacolor and Kodacolor processing from this New Jersey laboratory.

CUSTOM COLOR LAB 239
Custom Color Laboratory. Wall chart price list outlines services available from this California lab.

MOTION PICTURE PRODUCTION 240
Cine-Chrome Productions, Inc. Folder and price sheet gives complete information on new motion picture production service available from this California firm.

SUPPLIES

PHOTOGRAPHIC PRODUCTS 242
Ansco. 12-page catalog lists Ansco photographic products including film, paper and chemicals. Price list included.

GLASS BASE PLATES 243
Eastman Kodak Co. Revised edition of 6-page pamphlet, *Physical Characteristics of Kodak Glass Base Plates*, gives information of glass plates available from Kodak and describes specifications which can be supplied on special order.

CHEMICAL PRICE LIST 246
Philip A. Hunt Co. 34-page booklet gives prices for photographic, graphic arts and X-ray chemicals.

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NEW PRODUCTS

For additional information on any new product circle the appropriate number on the readers' service card, page 63.

GOWLANDFLEX CAMERAS **101**
Peter Gowland has announced the availability of his Gowlandflex cameras. These interchangeable lens, twin-lens reflex cameras are available in 4 x 5 and 5 x 7, have iris diaphragms on the viewing lenses as well as on the taking lenses. Price: $850.

PLANETARY CAMERA **102**
The X-1A 35mm camera, designed to incorporate the advantages of much larger 35mm overhead planetary camera equipment but requiring less space, power and price—has been announced by Datagraphic Systems Inc. The camera has a maximum copy size of 9 x 14 in. Special features include a foot pedal exposure button, exposure counter, blank frame spacer, step wedge exposure control, time control, film advance and glass copy holder.

MICROFILM READER **103**
Datagraphic Systems Inc. has introduced the RC-77 Micro-Film reader engineered for use with all types of unitized microfilm card systems (opaque cards excepted). The basic reader has 15X magnification and is operated by inserting the card in the scanning device, using the positioning controls and selecting the subject image for viewing on an 18 x 24-in. eye-level tinted screen. The unit accommodates card sizes up to 3¼ x 7⅜ in. A larger size scanning device can be specially ordered.

VOUGHT PERISCOPES **104**
Two periscopes, the VP-76 and VP-79, have been announced by the Vought Co. The VP-79 was designed to enable the viewer to inspect the after burner combustion process of a jet engine. Either visual or photographic information can be obtained. The overall length is approximately 12 ft. and the optical probe containing an adjustable first surface mirror and other optics is constructed of stainless steel. The VP-76 is of similar design but is of shorter length for installation directly on aircraft.

MINITAPE M-9 **105**
A portable, self-contained, battery-operated tape recorder, the Minitape M-9, has been introduced by Stancil-Hoffman Corp. The unit was designed for field operation and is powered by a self-contained, hermetically sealed nickel-cadmium storage battery which can be charged from a 12-volt cigarette lighter. The recorder weighs 13 lbs. in a drawn aluminum case which is 9 x 12 x 5 in.

MICROFILM DUPLICATOR **106**
DataGraphic Systems, Inc. has announced a semi-portable microfilm duplicator, designated the Model K. It is a self-contained, daylight operating table-top unit for the dry duplication of 16 and 35mm negative or positive film, perforated or unperforated. The Model K accommodates any length of film up to 1,000 ft. Reproduction is on diazo film—negative from a negative, or positive from a positive, at speeds up to 20 ft. per min.

MATCHED LENS SET **107**
A 7½-in. f/6.3 Wollensak Raptar matched lens set available for use on the Beattie Portronic Imperial 90 automatic studio camera has been announced by Beattie-Coleman, Inc. Using 3½-in. roll film, the new lens makes it possible to photograph a full 6-ft. subject at 15½ ft. filling only 75 per cent of the frame height. The matched viewing and taking lenses are mounted on a lens board and are priced at $175 a set.

CIRCULAR CONTACT SCREEN **108**
The graphic arts industry was introduced to the world's largest circular contact screen, a 40-in. pre-angled screen in magenta or grey, by Royal Zenith Corp. Developed by Policrom, the pre-angled circular screens are also available in 18, 24, and 31½-in. sizes, all up to 200 line.

AUDIO COMPRESSOR-LIMITER **109**
A general purpose audio compressor-limiter for use where the amplitude of the original sound is greater than the useful range of the recording or broadcasting equipment has been introduced by the Westrex Corp. The system is made up of an RA-1593-A amplifier (which consists of a three-stage push-pull program amplifier and a control amplifier) and an RA-1594-A control unit which contains the compression meter and operating controls. After initial settings are made on the control unit from a preliminary audio level test, the amplifier automatically compresses its output or chops peaks to keep the volume to within limits of the system.

HORIZONTAL CAMERA **110**
The Escort, a new 11 x 14 horizontal camera for the users of small offset plates, has been introduced by the W. A. Brown Mfg. Co. An all-metal camera with 9½-in. coated and color corrected lens, automatic diaphragm control, 19 x 23 glass covered copyboard, pressure back to hold film up to 11 x 14, calculator, 120-sec. timer and ground glass and frame its electrical requirements are 110-volt, 60-cycle, current.

PUMP FOR CORROSIVE LIQUIDS **151**
A centrifugal pump for continuous duty with certain chemicals and other corrosive liquids is introduced by Houston Fearless Corp. The pump body, face plates and impeller are made of Cycolac plastic, or can be made on special order from any material that can be injection-molded. Shaft and couplings are 316 stainless steel. "O" ring is neoprene. Motor is encased in aluminum. Pump is available with single-phase or three-phase motor.

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NEW PRODUCTS

(*continued from page 65*)

ZOOM LENS 112
A compact, lightweight zoom lens for the Camex-Reflex 8mm movie camera has been announced by Karl Heitz, Inc. Designated Angenieux-Zoom 9-36mm f/1.8 Varifocal it replaces wide-angle, standard and telephoto lens, providing a continuous zoom range of up to 4X magnification. Price with lenshood and filter holder: $149.

STOP-MOTION PROJECTOR 113
A 35mm analyst stop-motion projector for the study of all 35mm motion picture records including high-speed, normal or slow photography is being marketed by Camera Equipment Co., Inc. The projector has a 3½-in., f/1.9 lens and an aperture size of .825 x .600 in. or .680 x .970 in. (Additional apertures are available which will permit the entire width of the film to be projected.) Features include: variable speed from 8 to 24 pictures per second in both forward and reverse operation, positive single frame operation forward and reverse, a frame counter, 1000-ft. capacity reel arms and positive frame registration, plus or minus .0005 in.

AUTOMATIC TELE LENSES 114
A series of automatic telephoto lenses for either screw or bayonet mount cameras have been introduced by Agof Schacht Lens Corp. The lenses which are designed for use with cameras having internal coupling for automatic diaphragm control include the 135mm f/3.5 Travenar, featuring 4 elements, covering a field of 18°, focus from infinity to 5 ft. and stops down to f/22. Price: $89.95. Other lenses include the 85mm, f/2.8 Travenar and the 90mm, f/2.8 Travenar. Price: $93.95 each. All lenses are hard-coated, color correct and suitable for Exakta, Exa, Praktica, Pentacon, Pentax and Edixa Reflex cameras.

ILLUMINATED MAGNIFIER 115
Bausch & Lomb has introduced a 3X illuminated magnifier which features fully corrected 3X magnification and a wide field of view. The magnifier is 5 x 3 x 3½ in. and comes in either a battery operated or 115-volt model. Price $14.75 not including batteries.

MAGNETIC RE-RECORDER 116
The Westrex RA-1621 completely transistorized multiple unit magnetic re-recorder for motion picture film allows four separate channels of sound to be re-recorded onto a single channel of a magnetic film or disc master. Since each film drive unit is a separate module, two magnetic reproducers can be replaced with a magnetic recorder/reproducer and an optical/magnetic reproducer to provide, in one cabinet, a complete sound system for a small studio.

INSTRUMENT LUBRICANT 136
A disposable oiler which is actually a hypodermic syringe with a 1½ x .035 in. needle filled with fine instrument oil is now available from National Camera Repair School. The oil is said to meet Specification MIL-L-7870A. Price: 55¢ each, $6 a dozen.

CONVEYOR TIMER 137
A conveyor timer unit which may be installed on an overhead rail over various types of processing sinks and water jackets to provide automatic transport and timing has been announced by the Bald Eagle Corp. The unit features the Interchron Timer, in which 1 to 10 intervals of up to 30 minutes each can be timed in 10 second increments.

BERNALEN COLOR PROCESSOR 138
A complete Ektracolor Type C processing unit has been introduced by Bernalen Machine Specialties, Inc. The unit features, type 316 stainless steel heliarc construction; gas burst and bleed standby system; pressure regulator, timer and temperature controls. Basic price: $3,650.

VACUUM PUMP OIL 117
Vac-Lube, an oil compounded especially for vacuum pumps, has been announced by nuArc. It is said to provide maximum protection against rust, corrosion, varnish and sludges. Price for 1-pt. can with spout: $1.

EXTRA-LARGE PLAN FILE 139
An extra-large plan file, the LRF (large roll file) has been announced by Plan Hold Corp. It has a furniture steel housing for four duro-tubes and is available in seven sizes measuring from 2 to 5 ft. in length. The unit is 12½ in. wide and 12 in. high and can be stacked with basic Stack Roll File units to form a single, rigid file. The manufacturer claims it will accept a roll of plans, prints or drawings of any length up to 5 ft. Price: From $13.90 each. f.o.b. South Gate, Calif.

T.E.C. 140
Plymouth Products Co. has announced their thin emulsion compensating film developer, T.E.C. The compensating action of T.E.C. is said to cause it to minimize the density difference between the shadow and highlight areas thus reducing the excessive contrast usual with thin emulsion films. Developing action of T.E.C. is said to be evenly progressive and developing temperatures range from 60 to 80°F.

A 1-oz. bottle of T.E.C. makes 16 oz. of working solution which, it is claimed, will develop up to two rolls of film, 36-exposure 35mm, 120 or equivalent. Price: $1 for three 1-oz. bottles.

OPAQUE PROJECTOR 141
The Model 1000 Art-O-Graph, an opaque projector said to have a range of 5X reduction to 5X enlargement, has been announced by Art-O-Graph, Inc. It has an f/4.5 9½-in. Buhl lens, 10 x 14 front surface mirror and 600-watt illumination is supplied by four enlarger lamps. Construction is all-steel finished in gold hammer-tone.

The "1000" is said to render an image to desired scale, right side up of any photo, artwork or printed matter as well as three-dimensional objects, directly on a drawing board. The manufacturer claims no intermediate steps such as tracings or photostats are needed. The unit has an 11 x 11-in. copy opening and is said to project a full 15-in. newspaper width through a copy extension feature. Price: $397 f.o.b. Minneapolis, Minn.

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Get more information. Circle 403, page 63

by Samuel Lang & Leonard Zoref

INDUSTRIAL COLOR

New unit is a compact and moderately priced slide copy machine

Until recently there has been an unfulfilled need for a practical and moderately-priced piece of equipment to duplicate 35mm color transparencies. What has existed is either quite expensive or comprises attachments to enlargers or cameras, with the usual limitations of attachments. The Heiland Repronar, however, seems to answer the need. Its $300 price tag puts it within the reach of many with a use for color slide dupes.

The Repronar consists of a special 35mm single-lens reflex camera with an f/3.5 flat field 50mm copying lens, a helical rack for adjusting magnification, an easel with slide and filter holders, an electronic flash light source and an incandescent light source for viewing the transparency to be copied. Bellows extension is sufficient to permit copies in a range from 4X enlargement to ½X reduction.

It is obvious that a good deal of thought went into designing the unit, and it contains most of the features one would hope for in a slide copier.

The slide holders have a fixed position on the easel and are locked in with thumb screws—or the locking device can be bypassed and the copy held in place with magnets supplied with the unit. The magnet system permits simple adjustment of the position of the copy. We found them ideal for holding 16mm film flat on the easel while making enlargements.

Also supplied with the unit is a filmstrip mask and a filmstrip duplicating assembly. This promises to be a most useful feature. Unfortunately we did not have a chance to test it although we hope to do so soon. Accurate positioning counts for more in filmstrip duplicating than in slide copying, and production houses go to great lengths to achieve it. The accuracy of spacing between frames is of utmost importance because any consistent inaccuracy is bound to be cumulative, making the strip unusable on automatic projectors.

The use of an electronic flash source of illumination and daylight color films in the Repronar is a smart one. Through the use of filters electronic flash can be closely matched to the balance of the film, electronic flash is extraordinarily consistent and is both intense and low in contrast—two qualities that are highly desirable for copies.

Basic exposure and color balance information is supplied with the unit for use with Kodachrome, Ektachrome and Anscochrome. A rotating exposure scale combines the data for exposure vs magnification for these basic color films and provides an open scale for new films or special cases. It reduces computation to a minimum in using the Repronar.

A filter compartment accepts the UV-17 filter for Anscochrome or the 81A for Ektachrome or Kodachrome as well as any other gelatin filters, particularly color correction filters, needed for pleasing color in the copy.

The instruction booklet supplied with the unit is well written and informative. It includes sections on duplication in general, density and color balance correction, montages, superimposed titles and other special effects possible with the Repronar.

Contrast is important

While there is no denying that Kodachrome is superior to other color films in sharpness and image smoothness, its contrast is a drawback for copy work, and reducing the contrast with processing controls is impractical. In working with the unit, we found that the best results were obtained with Anscochrome or Ektachrome, using the old trick of overexposing and underdeveloping. Specifically, we overexposed one stop, developed Ektachrome E-2 about 7 min. in the first developer with no changes from normal in subsequent processing; Anscochrome processing was adjusted to 12 min. in the first developer and 10 min. in the color developer.

Another avenue to contrast control with the unit is flashing. This involves two exposures: one slightly underexposed and a low level fogging exposure. This second exposure in effect decreases the density range of the original. Although not mentioned in the instruction book, the technique is not at all inconvenient with the Repronar and it achieves pleasing results. Here's how it's done. First expose the copy film to the transparency at ½-stop less than the normal exposure. Second, remove the original transparency. Third, insert a 3.0 neutral density filter in the place of the original transparency. Lastly, double expose the copy film to the neutral density filter.

Using this technique, the color balance of the shadow areas can be changed by using a Wratten red, green or blue filter plus a 2.0 neutral density filter for the fogging exposure.

Possible refinements

While the Repronar appears to be well worth the $300 asking price, there are several improvements we would like to see. The camera itself is made in Japan and the rest of the unit is built in this country by Minneapolis-Honeywell, who, to our mind, have done the better job. Several parts of the camera appear somewhat flimsy—such as the diaphragm assembly and the reflex housing. The shutter cocking button for double exposures and the film rewind release button are not conveniently placed. If the cocking button were a short cable release instead, it would be much simpler to operate. A rapid wind handle seems almost a necessity if the unit is to be used for any volume of work, but probably not worth the investment unless you have a reasonable volume. We understand that there will be some refinements in a Model No. 2 to be available in the near future. The Repronar is a step forward and deserves more praise than criticism.

Correction

Tom Knowles, Supervisor of Photographic Services, General Electric Co., advises us that we erred in our May, 1960, article which contained a filter table for use with color films and fluorescent lamps. We referred to the decimal figure as a filter factor instead of directions for increasing lens stops. Read: The decimal figures are increased lens stops. For example, .3 means open the lens about 1/3 stop over normal. 1.0 means increase one stop or double normal exposure. 2.0 means increase two stops or four times the normal exposure.—THE END

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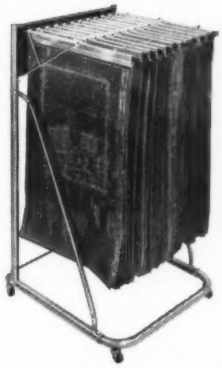

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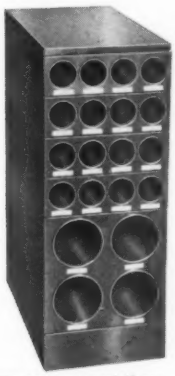

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by Lloyd E. Varden

PHOTO METHODS FOR TOMORROW

Columbia may offer six-year curriculum in photographic science

The new 14-story Engineering Center building is nearing completion on the campus of Columbia University. Quite a few thousands of square feet of space have been set aside for an Institute of Photographic Science and Engineering. If the plans of Dr. John Dunning, Dean of the School of Engineering, backed by Professor Frank H. Lee and Professor Howard Vreeland, who are faculty sponsors of the Institute, come to fruition, the United States will have its first school of photography at a university level.

Complete funds have yet to be raised to make the photographic institute a certainty, but present indications are that private endowments will be forthcoming so that the Institute can function in a strictly academic manner.

Ten years in the making

Outside of the New York City area few people seem to be aware of the photographic technology courses that have been given at Columbia University during the past ten years. None of the recent reports or listings of photographic courses offered by colleges and universities even mention the courses at Columbia. Yet, most of the Columbia courses are more advanced than those available at any other school.

When the courses in photographic technology at Columbia were instituted it was hoped that a degree course in photographic science and engineering could be developed within two or three years. The basic chemistry, physics, mathematics, mechanics and other required subjects to earn a degree are readily available at Columbia, and so a student desiring to graduate in photographic science and engineering would have only to take certain prescribed courses in these specialized areas. Unfortunately, this hope did not materialize, largely because it was recognized immediately that to teach students the advanced aspects of the photographic process considerable equipment was necessary, such as various types of sensitometers, various "ordinary" densitometers, a microdensitometer, a spectrophotometer, etc. Therefore, instead of making compromises, or excuses, the courses given at Columbia were listed in the catalog as "lecture" courses. However, the concept of a full-fledged, well-equipped photographic institute was plugged at every opportunity.

Now, after ten years, there appears to be some hope.

Plans for the Institute

At all times the Columbia Institute of Photographic Science and Engineering would have as its primary purpose teaching—but only at a technical level. In connection with the teaching program would be individual research projects which, in time, would encompass the entire field of photography, from practical emulsion preparation to pure research.

No undergraduate school is planned, although certain courses will be given at the undergraduate level if a student wants to qualify to take his graduate work in photographic science and engineering. It is very likely that an M.S. degree in photographic science and engineering will require six years, instead of the usual five years.

The whole idea seems right to me, and I hope that PMI readers agree. If you have the time, incidentally, a letter to Dean John Dunning would be helpful to him in arriving at a decision, but I am not asking that you write along my line of thinking. He needs random viewpoints. So naturally say whatever you think. His address is: Dean John Dunning, Columbia University. Administrative Office, 116th St. and Broadway, New York, N. Y.—THE END

MISSILE TRACKING

(*continued from page 57*)

or launch range, and the North or flight-impact range. Telescopes and cameras soon dotted the landscape and the hills all up and down the range to cover missile flights completely. The United States Navy Missile Test Facility, the Pictorial Division of the Signal agency, and the Electro-mechanical Laboratory were added to the growing roster of groups vitally interested in missile photography. By 1958 more than 200 cameras of various types and sizes were in use.

For a long time, the earlier telescopic units were built up from other available components. Leading in this kind of development were the Type II, III, IV, and V, all telescopic reflectors of apertures ranging from 10 in. (Types II and III) to 16 in. (Type IV). The focal lengths were increased from the basic 80 or 100 in. to over 300 in. by the use of relay lenses, Barlow lenses, and classical Cassegrainian telescope arrangements. These large reflecting telescopes were hard to mount for high angular accuracy, so the positional data was obtained instead from the Askania Cinetheodolites. These are large surveying-type instruments with motion picture cameras fitted in. The angular position accuracy was fairly high with these instruments even though, because of their short focal lengths, the missile images were no more than dots on the film frames. The larger telescopic cameras were used to give qualitative data of the missile flight and behavior.

Even with the longest focal lengths in use around 1950, approximately 300 in. (25 ft.), the image of a 60-ft. long "bird" seen at an angle of 45 degrees to its length at a distance of 100 miles (500,000 ft. approximately) was only about one one-hundreth of an inch, or about one quarter of a millimeter in length. With an overall resolution of about 40 lines per millimeter in the optical system, the image could only be resolved into about ten parts. Hardly enough to see much (but the White Sands groups were getting impressive data from these systems). Soon, however, the angular position data obtained from the Cinetheodolites became insufficiently accurate, and the inconvenience of having two separate optical units, the telescopic camera and the theodolite, became significant. The pressure was on for angular data from the larger telescopic cameras.

The principal difficulty in photographic recording of missiles at long range, beside the resolution requirement, is image contrast. Two major atmospheric effects cause the image contrast to fall to a point where it becomes a serious problem. The first is haze. Briefly, this is the glowing or brightening of the atmosphere between the missile and the camera causing the missile image to fill up with unwanted light or fogging. The second effect is the loss of atmospheric transmission. This means that the missile becomes dimmer. The two effects seem to work in conjunction with each other to reduce the contrast of the missile against the sky background. Another serious problem is the effective speed of the camera. At the longest focal lengths, the speed becomes f/16 to f/20, hardly enough for the high frame rates desired. These often went to 200 or more frames a second, with an actual exposure time of 1/1000 sec. or less. To top off the problems, the cameramen decided that, to improve the image contrast, yellow or red filters would be desirable. Efforts of the Eastman Kodak Company to produce a satisfactory film to meet these difficulties resulted in the development of Shellburst Linagraph film. This particular emulsion has become one of the most popular in missile photography. Its speed, coupled with a special ability to handle very small contrasts, and its moderate grain even under forced development made it very advantageous. In addition, the use of yellow and red filters requires that the film be panchromatic. Other film materials have since come along, but Shellburst remains one of the leading materials.

Because the position of the missile image is measured with reference to markings on the edge of the frame, called fiducials, with high precision, the film must be relatively stable. All of these requirements tie into the complete system performance.

Angular readout

Two larger cameras were developed with angular readout on the film or to associated recording equipment. The first of these was developed around a Navy gun mount by the Ordnance engineers at the Aberdeen Proving Ground and installed up-range at White Sands. It is called "Tetra" from the title Terminal Tracking Telescopic

(*continued on page 72*)

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MISSILE TRACKING

(*continued from page 71*)

Camera. It boasts an 18-in. parabolic mirror with a primary focal length of about 100 in. The film normally used is 70mm width (2¾ in.). Frame rates of up to 100 per second are attained. Auxiliary cameras such as the very high-speed Fastax are sometimes attached to the camera barrel and aimed by the operator together with the large unit. Here again, timing marks and frame fiducials permit obtaining accurate angle data. Basically, the main angular data is recorded from large dials integrally mounted in the camera pedestal. This information defines the center of the film frame. The offset of the missile image from the picture center is measured after the film is processed, yielding the remaining data necessary to define the missile's angular position with respect to the camera at the instant defined in turn by the frame number and the timing marks. The timing marks are frequently obtained by the use of a dot-raster on a cathode-ray oscilloscope tube driven by a precise oscillator. Because of its size the Tetra camera is guided by two observers, one for azimuth, the other for altitude. With this large camera exposure and focus became a serious problem. Stopping down the main optics resulted in a loss of resolution in extreme cases, and the heat of the sun on the camera during operation caused the structure to expand and sometimes warp sufficiently to show a loss in image quality. A new design was started by the Aberdeen Proving Ground engineers and culminated in the development and manufacture of the IGOR camera by the J. W. Fecker Optical Co. of Pittsburgh, Pa., a well-known astronomical instrument builder.

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4. The tracking is accomplished by 20 power telescopes, and a special electronic system driven from the nearby radar set, when the missile cannot be seen through the telescopes by the observers.

One specialized camera used extensively at White Sands is the CZR-1 or Bowen strip camera. Basically it is a high-speed motion picture camera with a frame size of one inch by five inches. A very high speed rotating shutter, with six narrow slits in it, reduces the exposure time for each frame to something like 1/10,000 sec. The film moves past the gate aperture steadily at a speed sufficient to produce up to 180 frames a second. The camera is oriented so that the long dimension of the frame will lie along the rocket's expected track. Auxiliary data including accurate timing marks are imprinted on each frame. The CZR-1 cameras are arranged in teams of four or eight along the ground in the direction of the rockets flight and on either side of the range. These cameras do not track the missile, but, because of their fixed position characteristics and their ability to be synchronized together, these cameras have yielded highly accurate data concerning the flights of smaller and medium-sized missiles.

In a subsequent article some of the most recent and highly advanced tracking cameras will be described. These include the Contraves EOTS Cinetheodolite, the TPR, the ROTI built by the Perkin-Elmer Corp. of Norwalk, Conn., and the huge SMTC recently completed by the Aberdeen Proving Ground engineers and installed at White Sands Missile Range.

MEMO ON LEASING

(*continued from page 47*)

chief photographer or similar person, and the publication pays him for it under a fixed fee. In general, the rate is set so that equipment is completely paid for at the end of the fourth or fifth year.

Like many other current business practices, leasing has grown because of the great demand for working capital and a tax structure which, in effect, promotes corporate spending (the expense account is probably the best-known example of this). In essence, it transfers capital expenditure from fixed to current expenses, with built-in amortization. Leasing has many advantages but the basic unpleasantness remains; it still costs money.—THE END

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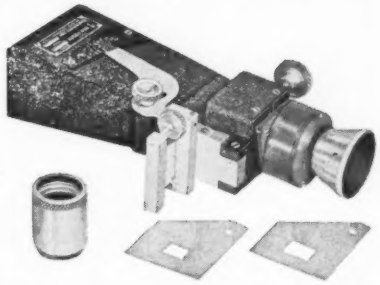

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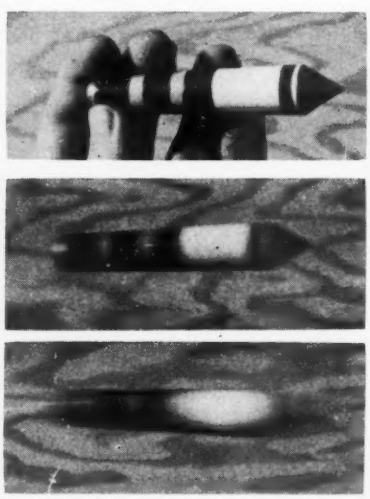
HYZER ON HIGH SPEED

(*Continued from page 59*)

chart in Figure 1, the fragment size, expressed in percent of field width (W), is P/W x 100 = 0.6/20 x 100 = 3 per cent. Drawing a vertical line from the 3 per cent abscissa to the curve corresponding to e = 4 per cent; then a horizontal line from this intercept to the ordinate scale, we find that our previous estimate of picture frequency should be multiplied by a speed factor of 4 to maintain blur within acceptable limits. The best estimate of picture frequency based on the above criteria therefore, is 4 x 10,000 = 40,000 frames per second.

Obviously, equivalent motion stopping performance is obtainable with faster shuttering action at lower picture frequency. If the top speed of the camera is 10,000 frames per second, a shutter constant of 0.2/4 = 0.05 is indicated at this speed. Fastax 16mm cameras, for instance, may be equipped with reduced height aperture plates to achieve this end result. Shutter speed characteristics of the Photo-Sonics camera and the Beckman and Whitley Dynafax may also be changed to meet special motion-stopping requirements. Reference to the Fastax manual reveals that a 0.005 in. high aperture slit would be required in this case.

Ed. note: The above article will appear in Mr. Hyzer's book, *Photographic Techniques of Motion Analysis*, to be published by The Macmillan Co.—THE END



Various degrees of image blur recorded against a distracting background. From top to bottom, e = 0, e = 3%, and e = 20%, respectively. Enlargement 6X.

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MECHANIZED RUSH

(*continued from page 37*)

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In all, the line from automatic or semi-automatic enlarger to pigeonhole sorting racks is about 25 ft. It's a very busy and highly productive 25 ft., however.

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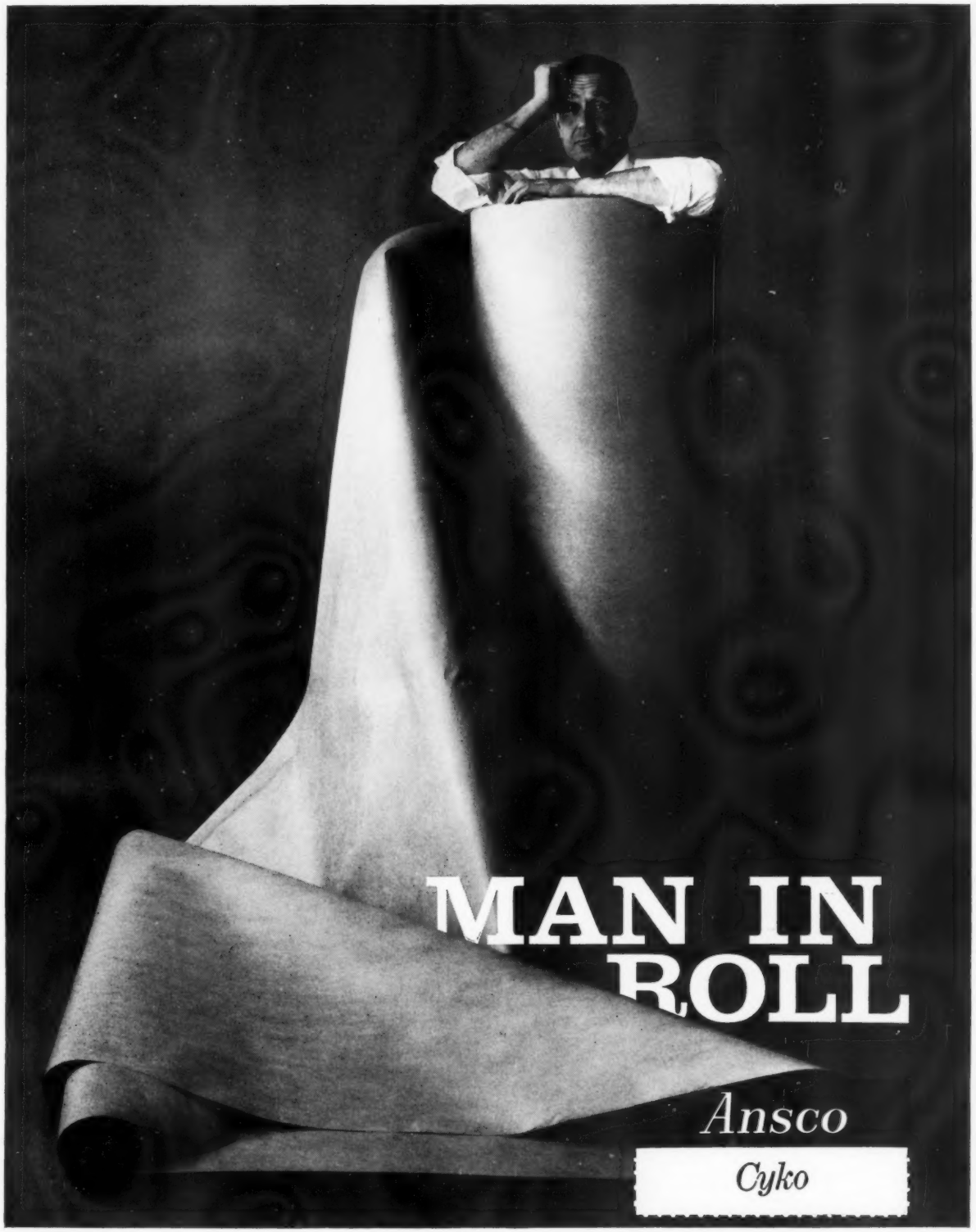

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